

everyday electronics

DEC. 71

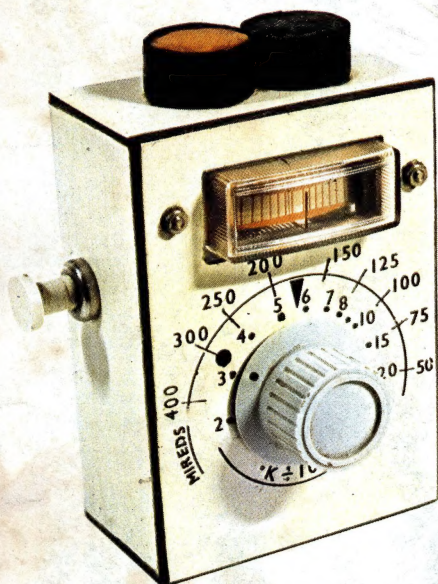
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A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit*. Standard temp. 360°C at 23 watts. Special temps. from 250°C—410°C.

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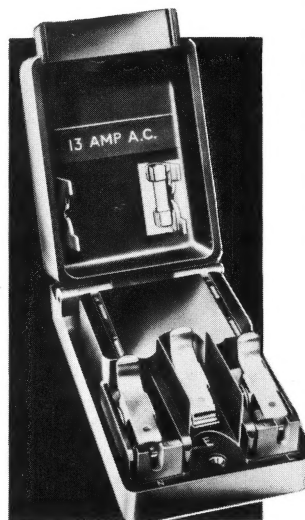
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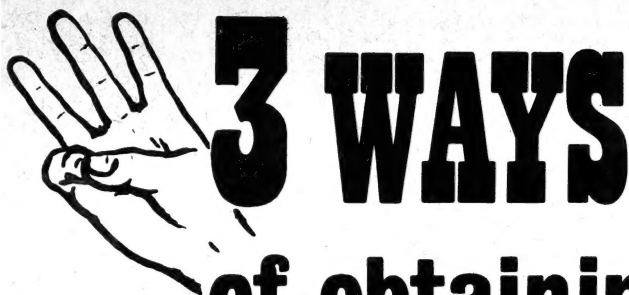
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1W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm. 4W Erie wire wound.

Power watts	Tolerance	Range	Values available	Price
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4	10%	1Ω-10Ω	E12	6p 5-5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ.
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

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Carbon track 5kΩ to 2MΩ, log or linear (log 1/2W, lin 1/2W).
Single, 12p. Dual gang (stereo), 40p. Single D.P. switch 24p.

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Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0.1 matrix).
Sub-miniature 0.1W, 5p each. Miniature 0.25W, 6p each.

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AC126	12p	BFY52	22p	OC81	12p	2N3055	72p
AC127	12p	BSY56	30p	OC82	12p	2N3702	15p
AC128	12p	BSX21	25p	ORP12	48p	2N3703	14p
AD140	40p	BY124	7p	IN4001	7p	2N3704	17p
AF115	20p	BYZ10	20p	IN4002	10p	2N3705	15p
AF117	20p	BYZ13	20p	IN4003	11p	2N3706	12p
BC107	10p	OA85	7p	IN4004	12p	2N3707	18p
BC108	10p	OA91	5p	IN4005	13p	2N3708	10p
BC109	10p	OA202	7p	IN4006	13p	2N3709	11p
BFY50	22p	OC71	12p	IN4007	13p	2N3710	12p
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2 1/2 x 5	24p	21p
3 1/2 x 3 1/2	24p	21p
3 1/2 x 5	28p	28p
17 x 2 1/2	75p	57p
17 x 3 1/2	100p	78p
17 x 5 (plain)	—	82p
17 x 3 1/2 (plain)	—	60p
17 x 2 1/2 (plain)	—	42p
2 1/2 x 5 (plain)	—	12p
2 1/2 x 3 1/2 (plain)	—	11p
Pin insertion tool	52p	52p
Spot face cutter	42p	42p
Pkt. 50 pins	20p	20p

JACK PLUGS AND SOCKETS

Standard screened	18p	2.5mm insulated	8p
Standard insulated	12p	3.5mm insulated	8p
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2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p. Socket 8p.

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9V mains power supply. Same size as PP9 battery.

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ASSEMBLY—SOLDERING—GLUING—WIRING—DRILLING ETC.

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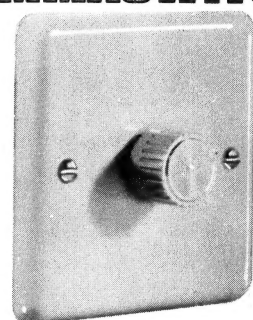
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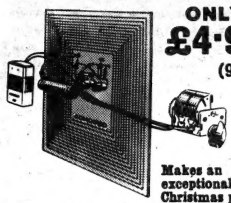
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CUTS OUT NOISE POLLUTION—SOOTHS YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator based on avalanche operated transistors. Beside being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. A group of Dentists have experimented on patients with this pink noise—NO ANESTHETICS WERE USED! The noise certainly created a most definite reaction on these patients, nervous systems with the results that their pain systems were blocked. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—use this amazing pink noise generator whenever you feel uneasy, can't relax or wish to concentrate. TAKE IT ANYWHERE, pocket sized. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life) CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, (a pair of crystal phones, Components, Nuts, Screws, Wire, etc. etc. no soldering. Send only £2.25 + 25p (45/- + 5/-) p. & p. parts available separately.)



SHORTWAVE TRANSISTOR RADIO Can be built in one evening

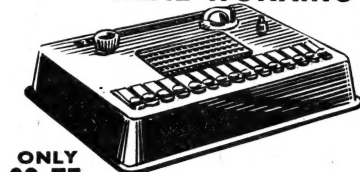
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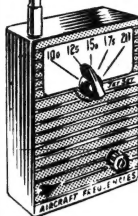
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Sinclair Q16/Micromatic

Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.

Loading: up to 14 watts RMS.

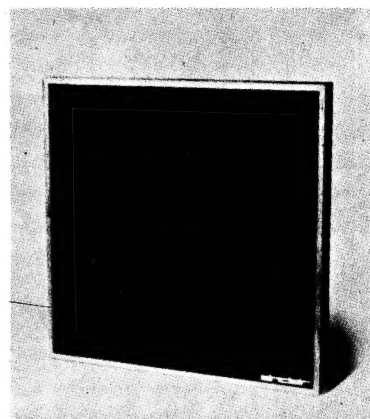
Input Impedance: 8 ohms.

Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.

Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.

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Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)

Weight: including batteries, 28.4 gm (1 oz.)

Case: Black plastic with anodised aluminium front panel and spun aluminium dial.

Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).

Earpiece: Magnetic type.

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Kit in pack with earpiece, case, instructions and solder **£2.48.**

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E.E. 2A

Sinclair Radionics Ltd., London Rd, St. Ives
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Telephone St. Ives (048 06) 4311

sinclair

Project 605 the new simple way to assemble Sinclair high fidelity modules



For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same – there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative – Project 605.

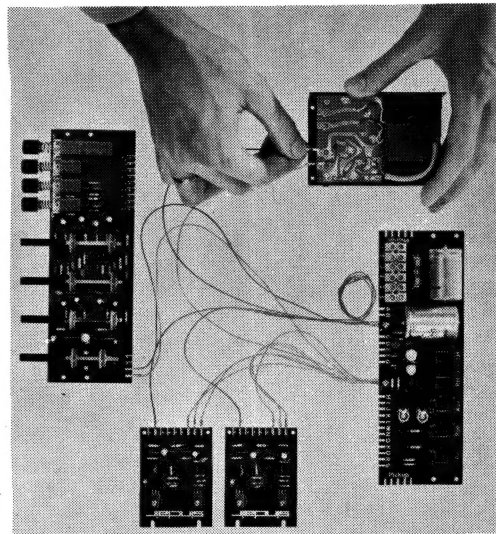
In one neat package you can now obtain the four basic Project 60 modules plus a fifth completely new one – Masterlink – which contains all the input sockets and output components you previously bought separately. Also in the Project 605 pack are all the inter-connecting leads, cut to length and fitted at each end with plugs which clip straight onto the modules, eliminating soldering completely. The pack contains everything you need to build a complete 30 watt stereo amplifier together with a clear well illustrated Instruction Book. All you have to do is to arrange your modules in the plinth or case of your choice and then clip them together – the work of a few minutes.

Your hi-fi system will, as we said, match the finest in the world and you can add to it at any time to increase power or extend the facilities. For example a superb stereo FM Tuner unit is obtainable for only £25.

Guarantee If within 3 months of purchasing Project 605 directly from us, you are dissatisfied with it, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail, Air-mail charged at cost.

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Specifications

Output – 30 watts music power (10 watts per channel R.M.S. into 3 Ω).

Inputs – Mag. P.U. – 3mV correct to R.I.A.A. curve 20–25,000 Hz \pm 1dB. Ceramic pick-up – 50mV. Radio – 50 to 150mV. Aux. adjustable between 3mV. and 3V.

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Channel matching within 1dB.

Front panel – brushed aluminium with black knobs.

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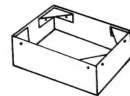
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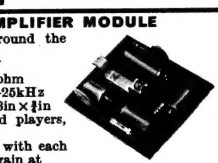
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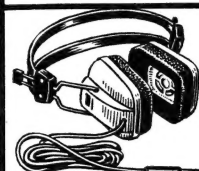


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6 B.A. 100 50p
4 B.A. 100 50p
2 B.A. 100 50p
METAL SPEAKER GRILLES
7 $\frac{1}{2}$ in. x 3 $\frac{1}{2}$ in. 6 50p
EARPIECES, MAGNETIC
No Plug 6 50p
2.5mm Plug 4 50p
3.5mm Plug 4 50p
500 MICRO-AMP LEVEL METERS
1 50p
VEROBOARD, TRIAL PACK 5 BOARDS + CUTTER
50p

TRANSISTORS
P.N.P. Untested but mainly O.K. 50 50p
N.P.N. Untested but mainly O.K. 50 50p
O.C.P. 71 equivalent 5 50p
Light-sensitive Diodes 10 50p
(These produce up to 1ma from light)
OC44 Mullard 1st grade 4 50p
OC45 Mullard Boxed 5 50p
2G378 Output, Marked 5 50p
2G371 Driver, Marked 5 50p
ASY 22, Marked 5 50p
BY 127 Rectifiers 4 50p
IN4007 Rectifiers 4 50p
(1200V peak)
STC 3/4 Rectifiers 5 50p
DIODES (OA 81 & OA 91) 40 50p
WIRE
Solid Core. Insul. 100yds. 50p
Stranded ditto 50yds. 50p
SOLAR CELLS
Large Selenium 2 50p
Small 3 50p
(6 cells will power a Micro-matic radio)
CO-AXIAL CABLE
Semi Air-spaced 15yds. 50p
CRYSTAL TAPE RECORDER
1 50p
CRYSTAL EARPIECES
3.5mm Plug 2 50p
TRANSISTORISED Signal Injector Kit
1 50p
TRANSISTORISED Signal Tracer Kit
1 50p
TRANSISTORISED CAR REV. COUNTER KIT (Needs 1 ma. meter as indicator)
1 50p

Unrepeatable Offer ! ! !
Surplus VEROBOARDS, $3\frac{1}{2}$ " x $2\frac{1}{2}$ " x .15"
Only 10p each or £1.00 per dozen

TANTALUM CAPACITORS. COMPARE THE PRICE—ONLY 10p EACH ! ! !

Sub-miniature types	Miniature types	5-6 μ F	35 volts
0-047 μ F 50 volts	0-022 μ F 20 volts	8-2 μ F	10 volts
0-056 μ F 50 volts	0-033 μ F 20 volts	15 μ F	35 volts
0-07 μ F 20 volts	0-047 μ F 20 volts	18 μ F	35 volts
0-1 μ F 20 volts	0-068 μ F 35 volts	22 μ F	15 volts
0-18 μ F 50 volts	0-12 μ F 35 volts	27 μ F	120 volts
0-18 μ F 20 volts	0-15 μ F 35 volts	56 μ F	15 volts
0-33 μ F 35 volts	0-22 μ F 50 volts	56 μ F	20 volts
0-47 μ F 35 volts	0-47 μ F 50 volts	150 μ F	6 volts
0-68 μ F 20 volts	0-68 μ F 35 volts		
1-0 μ F 15 volts	0-68 μ F 50 volts		
2-2 μ F 3 volts	1-0 μ F 35 volts	Standard	
2-7 μ F 15 volts	1-0 μ F 75 volts	6-8 μ F	50 volts
2-7 μ F 35 volts	1-8 μ F 20 volts	7-5 μ F	20 volts
3-0 μ F 12 volts	2-2 μ F 20 volts	8-2 μ F	150 volts
10-0 μ F 1-5 volts	2-7 μ F 50 volts	12 μ F	35 volts
	3 μ F 12 volts	12 μ F	50 volts
	3-3 μ F 15 volts	39 μ F	20 volts
	4 μ F 20 volts	82 μ F	20 volts
	4-7 μ F 35 volts	050 μ F	15 volts
	5-6 μ F 6 volts	270 μ F	6 volts

NEW ! NEW ! NEW ! NEW !

An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly.

Method: Spray copper laminate board with light-sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light. (No need to use ultra-violet.) Spray with developer, rinse and etch in normal manner.

Light sensitive aerosol spray £1
Developer spray 50p

STOCKTAKING CLEARANCE! IMPOSSIBLE TO REPEAT!

We have huge numbers of components in quantities too small to advertise individually. In order to "clear the decks" we have made up parcels containing a mixture of carbon and wire-wound resistors, electrolytic and paper capacitors, controls, transistors, diodes etc., for a tiny fraction of normal price. It is emphasised that these are mixed parcels only—contents cannot be stipulated! Sold only by weight.

Gross weight 2 lb. £1 (postage 20p)
Gross weight 5 lb. £2 (postage 30p)

G. F. MILWARD, Drayton Bassett, Tamworth, Staffs. Postage (minimum) per order 15p.

WELCOME NEW READER ! !

For those of you who haven't heard of LST:—

LST are one of the oldest companies in Electronics Mail Order.

LST have a reputation for quality and service second to none.

LST stock only top quality components from the biggest names in Electronics.

LST's prices are the lowest possible commensurate with quality.

LST's 44 page catalogue is available FREE, the only Company to our knowledge making this offer!



SPECIAL EXPERIMENTORS BARGAIN PACK OFFER!

To introduce the new reader to electronics—a fascinating hobby—LST are offering for a limited period only a special package deal containing common transistors & diodes, common values of resistors and capacitors, solder, circuit board, and other useful brand new components at the special bargain price of £2—Our normal catalogue price over £4!!! Just place a tick in the box—tear out coupon, fill in your name and address, LST will ship your catalogue (free) or your bargain pack (£2) by return.

£2

CUT OUT THIS COUPON →

LST ELECTRONIC COMPONENTS LTD.,
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7 COPTFOLD ROAD,
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SEND YOUR FREE CATALOGUE



TICK BOX

STOCKISTS-DISTRIBUTORS OF: IR, WELER, MULLARD, NEWMARKET, SIEMENS, RCA, ISKRA VEROBOARD, S-DECS, TEXAS, G.E., MOTOROLA.

9 Vol Gramophone Unit. Collaro battery operated with pick up on unit plate. 4 speed auto-stop turnover cartridge. Price **£25.50** plus 40p post and insurance.

Buy Time Slot Meter. Made by Sangamo Weston. 3 types—one for each coin, 2p, 5p or 10p. Price **£1.75** each plus 25p post and insurance.

Photo Electric Kit. Contains photo cell, relay, transistor and all parts to make light operated switch. Originally £2. Limited quantity to clear. **£1.25** plus 20p post and insurance.

Desk/Hand Mike. Made by Acos. Crystal insert in neat plastic case which opens at right angles for desk or opens completely for hand holding. Good general purpose mike. Price **85p** each.

Printed Circuit Kits. Hagato Pk. 3 facilities in kit form include pick-up, phono, resist, removal, polishing and complete manufacturing of printed sets to own specifications. Price **£1.25** + 20p.

DEMO DECK

as described last month
£6 post free

Laboratory Instruments. For horizontal use in strong black reinforced bakelite cases with screw terminals especially suitable for experiments and demonstrations. All have precision meters (manufacturers quoted accuracy of better than 1-5%). Following available:

D.C. Voltmeter 0-300v. f.s.d. moving coil mirror scale meter size approx. $5 \times 4\frac{1}{2} \times 1\frac{1}{2}$ in. Price **£1.75**.

D.C. Voltmeter 0-30v. f.s.d. moving coil mirror scale meter. Size approx. $5 \times 4\frac{1}{2} \times 1\frac{1}{2}$ in. Price **£1.75**.

AC/DC Milliammeters 3 range, moving mirror scale meter. Range selection 25, 50 and 100mA by selection switch mirror scale (coil resistance marked) size, $7\frac{1}{2} \times 5 \times 3\frac{1}{2}$ in. type 35999/1. Price **£9.75**.

Microammeter 100 micro amps f.s.d., moving coil mirror scale precision meter (coil resistance marked) size, $5 \times 4\frac{1}{2} \times 2\frac{1}{2}$ in. type M109/1. Price **£3**.

Galvanometer 20-0-20 f.s.d. moving coil precision laboratory instrument of extremely high sensitivity (3×10^{-7} A per division). Size approx. $6\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{1}{2}$ in. Price **£5**.

Parmeko Neptune Series C. Core Transformers. These transformers are beautifully made, steel encased, stove enamelled black, upright mounting. All have normal 50cps. primary 230/240v. with primary screen and are new and unused. Small quantities only of each type available as follows:

Model 6000/79. 275-0-275v. at 330mA, and 6.3v. at 4.6a. Price **£4.50**, + 50p post.

Model 6000/71.290-215-0-215-290 at 125mA, and 2 at 6.3v. 6a. Price **£4.50** + 40p post.

Model 49. 250v. 100mA, 6.3v. at 3a., 5v. at 0.75a. Price **£2** + 30p post.

Model 47. 620-0-620 at 9mA. 4v. at 1A. Price **£4.50** + 40p post.

Parmeko Neptune C. Core Chokes. These are encased and match the transformers above.

Model 6000/73 4H at 500mA. **£2.50** + 40p post.

Model 55. 10H at 1mA. **£2.50** + 40p post.

Model 49. 10H at 70mA. **£1.50** + 30p post.

Model 69. 10H at 110mA. Price **£2** + 40p post.

Fuse Holders. Heavy duty type B.S.S. 88 440. Reyrolle power fuse holders. English Electric type S.100.1, ex. equipment. Price **50p**.

Fuses. H.R.C. 100A, 160A type EA.....Eng. Electric 100A, 160A, type 54TF.....Kantark 60 A., new, all at 25p each.

Electronic Car Ignition. In addition to the kits for 12v. cars we can also supply systems for 6v. cars. These are not kits but made up and ready to work. Price **£5.50** + 30p post.

Carbon Resistors. We are now stocking these in a big way and will be pleased to quote special prices to quantity buyers. Made by Erie. Morganite or Dubillar.

Price each
1-9 10-99 100-999 1,000 up
1 watt 1p 8p 6p 5p
2 watt 2p 15p 15p 125p
4p 32p 30p 275p

Special Resistor Assortment Offer (1). 100 x 1 watt resistors made up of 2 each of 50 different values fairly evenly spaced between 1 ohm and 10 meg. Price **50p**.

Special Resistor Assortment Offer (2). 1,000 x 1 watt resistors made up of 20 each of 50 different values fairly evenly spaced between 1 ohm and 20 meg. Price **£4**.

Special Resistor Assortment Offer (3). As offer 1 but 1 watt. Price **£1**.

Special Resistor Assortment Offer (4). As offer 2 but 1 watt. Price **£8**.

12 Way Sub-Miniature Multi-core Cable 7-0076 copper cores, each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. $\frac{1}{8}$ in. dia. Price **20p** per yard.

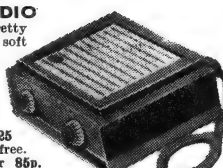
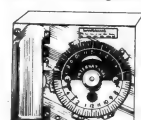
DRILL CONTROLLER
NEW IKW MODEL
Electronically changes speed from approximately 10 revs. to max. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1.50** plus 13p post and insurance. Made up model also available. **£2.25** plus 13p post and p.

Neon Indicator Lamps. With amber lens, standard type with built in resistor for mains. 10p each, 10 for **90p**.

Condensers. Another addition to our range. 500pF at 50v. 15p each, 10 for **£1.25**.

MICROSONIC KEY CHAIN RADIO

7 transistor Keychain Radio in very pretty case, size $2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$ in.—complete with soft leather zippered bag. 7 transistor, ferrite rod, loudspeaker.
In transit from the East these sets suffered corrosion as the batteries were left in them but when this corrosion is cleared away they should work—offered without guarantee except that they are new. Price only **£1.25** less batteries plus 13p post. 6 for **£7** post free. Pair of rechargeable batteries and charger **85p**.



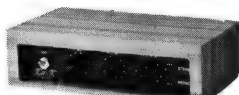
FUZZ BOX

and colour temperature meter featured in this issue. To receive these kits quickly, send quoted approx price and any change due will be refunded.

24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into with 15A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. **£2.50** post and ins. 23p. Additional time contacts **50p** pair.

THE FULL-FI STEREO SIX



The amplifier

sensation of the year
You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished

to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. **UNREPEATABLE PRICE** is **£9** plus 38p post and insurance.

THIS MONTHS SNIP

POCKET CIRCUIT TESTER



Test continuity of any low resistance circuit, house wiring, car electric. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied). **30p** or 2 for **50p** post paid.

TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. **£3.50**. 2kW Model as above except 2 kilowatts **£2.50**. Don't miss this. Control Switch **85p**. P. & P. 40p.



LAST MONTH'S FEATURES

Kits of parts available as follows:—

HOME SENTINEL INTRUDER ALARM

Complete kit, with case **£3.75**.

SNAP INDICATOR

All components but not case or battery **75p**.

WINDSCREEN WIPER CONTROL

All components including metal for chassis **£1.50**.

RECORD PLAYER

All components, but not case, loudspeaker, record deck or pick-up **£5-15**

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2** less plug **£2.25** with fitted 13 amp plug; **£2.40** with fitted 15 amp plug, plus 23p P. & I.



CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the Wireless World about a year ago. We can supply kit of parts for improved and even more efficient version (P.W. June), price **£4.95**. When ordering please state whether for positive or negative systems. Plus 30p post.



15 WATT 12in HI-FI SPEAKER

Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 15W R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in.—12 1/2 in. over mounting lugs. Overall height 5 1/2 in. A £10 speaker offered this month for **£3.75** plus 30p post and insurance.



70 THINGS YOU CAN MAKE

Send S.A.E. today for list of 70 constructor projects—instruments—alarms—counters—locks—radios, etc., etc.

0-8 AMMETER

2 in. square full vision face for flush mounting. Moving iron instrument. Ideal for charger. Price **45p** each. 10 for **£3.00**.



PAPET MINIATURE EXTRACTOR FANS

Beautifully made as are all paper motors. Intended for cooling computers but suitable for any equipment. Size 4 1/2 in. square and 1 1/2 in. thick. Price **£2** each. Post and insurance 20p.



24hr CLOCK SWITCH

In metal case with 13 amp socket. Smiths movement, 2 on and 2 off per 24 hours. Very neatly made and finished. Original retail price **£7** each. Few only, new and perfect. **£4.00** each.



NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3. Price **£1.45** each. 10 for **£13**.



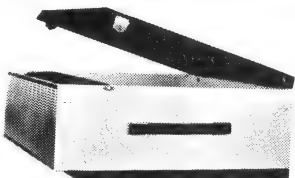
SNAP ACTION SLIDE SWITCH

Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. **5p** each. 10 for **45p**.



J. BULL (ELECTRICAL) LTD.
(Dept. E.E.) 7 Park Street, Croydon CRO 1YD

PHILIPS PORTABLE PLAYER CABINET

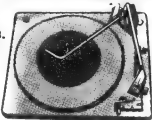


Size 18 x 15 1/2 x 7 1/2 in. Cut for B.S.R. UA12/14/15/16/25 deck. Amplifier space 14 x 5 x 3 1/2 in. Satin aluminium front grille. Really smart appearance. £4 Post 25p
Black/White. Chrome fittings.

BSR C.109 SUPERSLIM

STEREO AND MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250V. Size 18 1/2 x 11 1/2 in. Above motor board 3 1/2 in. below motor board 2 1/2 in. with STEREO and MONO XTAL £7.75 Post 25p



GARRARD SINGLE PLAY TA Mk II Stereo/Mono £10
GARRARD PLAYERS with Sonotone GTA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk II £15
Model 2500 Stereo and Mono Autochanger £14. Post 25p.

RECORD PLAYER PORTABLE CABINET £3.75

With space for R.C.S. Amplifiers and most modern autochangers. Two-tone rexine covered. Post 25p
RCS DE-LUXE 3 WATT AMPLIFIER. Ready made with 2-stage triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer, knobs, loudspeaker valves ECL82, E280. Response 50-12,000 cps. Sensitivity 200mV. Post 25p. £4

R.C.S. TEAKWOOD BASE. Ready cut out for mounting (State player make and model). £2.75

R.C.S. PLASTIC COVERS FOR ABOVE BASE. £2.75
Durable tinted plastic, attractive appearance.

EMI PICK-UP ARM with mono xtal and stylus £1.25
HI-FI PICK-UP CARTRIDGES. Diamond Stereo/Mono. GTA £2.50; GP94 £2.50; GP93 £2.00; Mono GP91 £1.50; GC8 £1.25; ACOS L.P. only 60p.

AM-FM/VHF TUNING GANG

Super quality small size 1 1/2 x 1 1/2 in. plus spindle 1 1/2 x 1/16 in. 365 + 365 pF with 25 + 25 pF. British made. Geared slow motion drive 6:1. Plastic dust cover. 6BA tapped front fitting. Cast aluminium frame £50p Post Free

WEYRAD P50-TRANSISTOR COILS

RA2W Ferrite Aerial... 65p
Osc. P50/1AC... 30p
I.F. P50/2CC 470 kc/s... 33p
3rd I.F. P50/3CC... 33p
P51/1 or P51/2... 33p
P50/3... 33p
OPTI... 55p
Mullard Ferrite Rod 8 x 1/2 in. 20p, 6 x 1/2 in. 25p.

VOLUME CONTROLS

Low spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p

WIRE-WOUND 8-WATT POTS. Small type with small knob. Values 10 Ω to 30 K. 25p
WIRE-WOUND 3-WATT STANDARD SIZE POTS. 10 OHMS to 100 K. 40p

VEROBAND 0.15 MATRIX 2 1/2 x 5 in. 19p. 2 1/2 x 3 1/2 in. 16p. 3 1/2 x 3 1/2 in. 19p. 3 1/2 x 5 in. 26p. EDGE CONNECTORS 16 way 25p; 24 way 38p. PINS 36 per packet 17p. FACE CUTTERS 38p. S.R.B.P. Board 0.15 MATRIX 2 1/2 in. wide 3p per lin., 3 1/2 in. wide 4p per 1 in.; 5 in. side 5p per lin. (up to 17 in.). S.R.B.P. undrilled 1 1/2 in. Board 10 x 5 in. 15p.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2 1/2 in. sides. 6 x 4 in. 45p; 8 x 6 in. 50p; 10 x 7 in. 70p; 14 x 9 in. 90p; 16 x 12 in. 120p; 18 x 12 in. 150p.

ALUMINIUM PANELS 18 s.w.g. 6 x 4 in. 8p; 8 x 6 in. 15p; 10 x 7 in. 17p; 12 x 6 in. 23p; 14 x 9 in. 27p; 12 x 12 in. 35p.

1 1/2 in DIAMETER WAVE-CHANGE SWITCHES 25p. 2 p. 2-way, or 2 p. 6-way or 3 p. 4-way 25p each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 25p. 1 inch DIAMETER Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way, 1 water 60p, 2 water 90p. Extra wafers up to six 30p each.

TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 25p.

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER £2.35 Post 15p



Minimum Post and Packing 15p

RETURN OF POST DESPATCH.

HI-FI STOCKISTS.

CUSTOMERS FREE CAR PARK.

CALLERS WELCOME

RADIO COMPONENT SPECIALISTS

List 5p. Written guarantee with every purchase. (Export: Remit cash and extra postage.) Buses 133, 68 pass door. S.R. Stn. Selhurst. Tel. 01-684-1665

R.C.S. STABILISED POWER PACK KIT

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240V. A.C. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V. DC at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. £2 POST FREE Details S.A.E.

GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

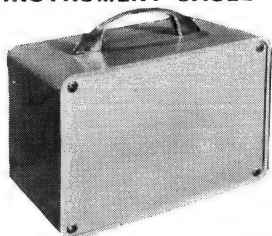
for Mike, Tape, P.U., Guitar, etc. Battery 9-12V or H.T. line 200-300V D.C. operation. Size 1 1/2 x 1 1/2 x 1". Response 25 c.p.s. to 25 Kc/s. 28dB gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. 90p Post 10p

NEW TUBULAR ELECTROLYTICS CAN TYPES
2/350V 14p 250/25V 14p 18-18/500V 55p
4/350V 14p 500/25V 20p 50+50/350V 35p
8/450V 14p 1000/25V 35p 60+100/350V 58p
16/450V 16p 1000/50V 47p 32+32/250V 18p
32/450V 20p 8+8/450V 18p 32+32/450V 33p
25/25V 10p 8+16/450V 20p 50+50/350V 50p
50/50V 10p 16+16/450V 25p 32+32+32/350V 45p
100/25V 10p 32+32/350V 25p 100+50+50/350V 48p
SUB-MIN. ELECTROLYTICS 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 35p. CERAMIC 1pF to 0.01 mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0.1 4p, 0.5 18p; 1mF 15p; 2mF 150V 15p. 500V-0.001 to 0.05 4p; 0.1 5p; 0.25 5p; 0.47 25p. SILVER MICA. Capacitors 1 pF to 500pF 5p; 500-2000pF 10p; 2.7-500pF 20p; 6.8-100pF 0.01 mF 30p; each. TWIN GANG. "0-0" 208pF + 176pF, 65p; Slow motion drive 365 + 365 with 25 + 25pF, 50p 500V slow motion, standard 45p; small 3-gang 500pF £1.10. SHORT WAVE. Single 25pF 55p CHROME TELESCOPIC AERIAL, swivel base, 23in. 20p. TUNING. Solid dielectric. 100pF. 500pF. 35p each. TRIMMERS. Compressor. 100pF. 50p; 100pF. 150pF. 8p; 250pF. 10p; 600pF. 10p; 750pF. 10p; 1250pF. 10p. SILICON REC. 40- LUCAS 2DS500 Bridge 70V 5 amp £1 RECTIFIERS CONTACT COOLED 1 wave 60mA 38p; 85mA 48p. SILICON BVY130 30p; BVY100 30p; BVY127 30p. EX-GOVERNMENT RECTIFIERS 250V, 200mA, 30p. NEON PANEL INDICATORS 250V A.C. 100p or Amber 20p. 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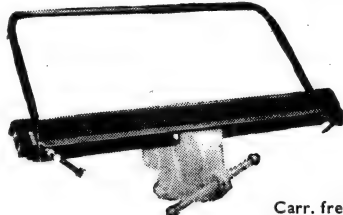
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PROJECTS...
THEORY.....

A DELICATE TOUCH

To anyone not previously familiar with the technical aspect of electronics, the constructional projects included in last month's issue were probably quite revealing. Not least in the modest quantity of parts involved and their small size. It is really surprising what can be achieved with just a few tiny components which one could hold quite comfortably in the palm of the hand.

Maybe it looks altogether too simple for words. And in a sense it is. But beginners should take their first steps with thought and care, and be duly appreciative of the need to develop a certain dexterity in the manual work involved: in the manipulation of the components and wiring, and in the making of good sound soldered joints. A delicate touch closely akin to that of the scientific instrument maker is the kind of manual skill required in modern electronic construction work.

WHAT'S IN A NAME?

It will be noted that we frequently use the word "gadget" as a general term of convenience applicable to most of the constructional projects featured in this magazine. We employ the word in its original sense, meaning a small fitting or contrivance. However, modern usage has tended to downgrade the word gadget so that in some minds it has become synonymous with "gimmick."

To avoid any misunderstanding, we must explain that all designs offered to private con-

structors are practical items, capable of providing definite useful functions. True some may have a rather more serious application than others, but all are designed to a purpose. For the want of a better or more appropriate term, "gadget" will continue to be used when referring to the small items of electronic equipment. But gimmicks pure and simple, or gimcrack items, will not be our concern.

PROVED DESIGNS

One further point must be made clear in this connection. All EVERYDAY ELECTRONICS projects are tested and proved by our own technical staff prior to being presented to our readers. We do not deal in "paper designs." A hobby is a hobby: nevertheless time is a valuable commodity, none more so than the "spare" variety. We want to help our readers use it profitably, enjoyably, and economically.

STOP PRESS

Our thanks to those who have already written following the publication of our first number. Next month we will publish a selection of readers' letters. We welcome all views, so why not drop us a line if you have not already done so?



Our January issue will be published on Friday, December 17

EDITOR F. E. BENNETT

ART EDITOR J. D. POUNTNEY

M. KENWARD

P. A. LOATES

ADVERTISEMENT MANAGER D. W. B. TILLEARD

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....EASY TO CONSTRUCT
....SIMPLY EXPLAINED



VOL. 1 NO. 2

DECEMBER 1971

CONSTRUCTIONAL PROJECTS

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Special Offer

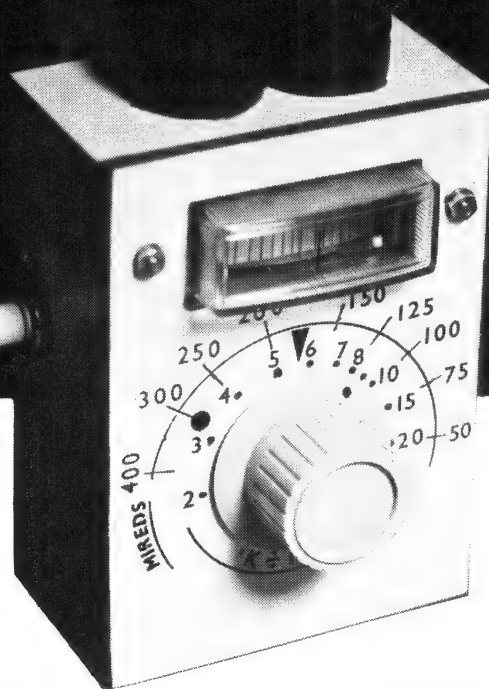
As a service to all our readers and especially those who are new to electronic construction we offer the Everyday Electronics Tool Kit at a special price. For further details of this offer see page 97.

Everyday Electronics, December 1971



Photographic Colour Temperature Meter

By D. Bollen



Get the colours right with this Photographic Colour Temperature Meter. It tells you simply and quickly what correction filters to fit to your camera.

PHOTOGRAPHERS who use reversal film to make colour transparencies often find that a particular shot turns out to have an unnatural red, yellow, or blue tinge. Unlike the human eye, a colour film cannot compensate for small changes in the "quality" of daylight and other light sources.

A film correctly balanced for standard daylight will record subjects under household tungsten lamp illumination with a deep red hue, but the most perceptive photographer sees the same scene as no more than orange-yellow. Similarly, a subject in shade under a clear blue sky is depicted as deep blue by the film, but is seen as bluish grey by the eye.

A simple colour temperature meter of the type described here will help to reduce the number of failures on a roll of film by showing when colour casts are present, and will also assist in the selection of camera filters to eliminate such casts.

COLOUR TEMPERATURE

If a black body such as a piece of carbon, is heated, it will exhibit a range of colours as its temperature increases, from a dull red, through orange and yellow, to a bluish white. Obviously, the colour of the carbon is closely related to its temperature, and the characteristics of most common light sources are close enough to that of

Approximate cost of components



2.75 plus case

Components....

Resistors

R1 1k Ω
R2 2.2k Ω

All $\pm 10\%$, $\frac{1}{2}$ watt carbon except where stated.

Potentiometers

VR1 100 Ω horizontal skeleton pre-set
VR2 2k Ω slider type pre-set
VR3 500 Ω wire wound (1 watt type)

Light Dependent Resistors

PCC1, PCC2 ORP12 (2off)

Meter

ME1 100-0-100 μ A moving coil centre zero, stereo balance type

Switch

S1 Single pole push-to-make

Miscellaneous

B1 9V PP3 type
Cellophane (see text), knob with pointer.
Plain perforated s.r.b.p. board 2in x 1 $\frac{1}{2}$ in x 0.15in matrix and pins.
Formica for case or suitable plastic box.
Connecting wire
Battery connectors.
L.D.R. Holders (see text).

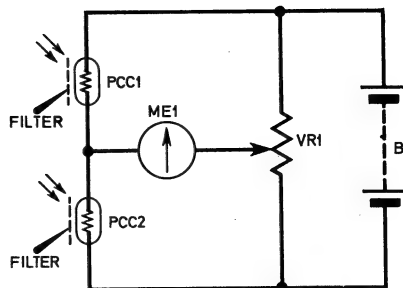


Fig. 1. Basic circuit diagram.

CIRCUIT OPERATION

It would be possible to wire the two photosensors in such a way that colour temperature could be read straight from a voltmeter scale, but this would involve taking the meter to bits for calibration, and an unwanted load would be placed on the photosensors by the internal resistance of the meter. Such an arrangement would also be sensitive to changes in battery voltage, so a nulling technique was chosen for the colour temperature meter, using an easily calibrated potentiometer.

In the basic circuit of Fig. 1, the photosensors are light dependent resistors (l.d.r.s) PCC1 and PCC2. The resistance of these l.d.r.s decreases when they are exposed to light. As long as both sensors are equally illuminated they should have similar resistance values irrespective of light intensity, and the voltage at the junction of the sensors will remain constant. The slider of potentiometer VR1 in Fig. 1 is adjusted to give the same voltage as the sensors so no current flows through centre-zero ME1, hence, no load is placed on the sensors.

Assume now that sensors PCC1 and PCC2 are provided with blue and red filters respectively. Under even illumination of both sensors, light

Table 1: COLOUR TEMPERATURE OF LIGHT SOURCES

Source	Temperature in degrees Kelvin
Candle	1,900
100 watt household lamp	2,800
Photoflood lamp	3,400
Direct sunlight, sunrise or sunset	2,000-4,000
Direct sunlight, noon	4,500-5,500
Sunlight plus white clouds or haze	5,900
Electronic flash or blue flash-bulbs	5,900
Sunlight plus clear blue sky	6,650
Light overcast	6,650-7,150
Heavy overcast	8,350
In shade, sunlight plus white clouds or haze	7,150
In shade, clear blue sky	9,000-25,000

a black body to allow a similar correlation between colour and temperature to be used. Table 1 lists the equivalent colour temperatures of several kinds of light source.

One way of measuring colour temperature is by means of two photosensors, one behind a red filter and the other behind a blue filter, with the filters adjusted so that the sensors give equal outputs under standard daylight conditions. If the photosensors are then illuminated by a light source which is either more red or more blue than standard daylight, the sensor outputs will differ by an amount roughly proportional to the change of colour temperature.

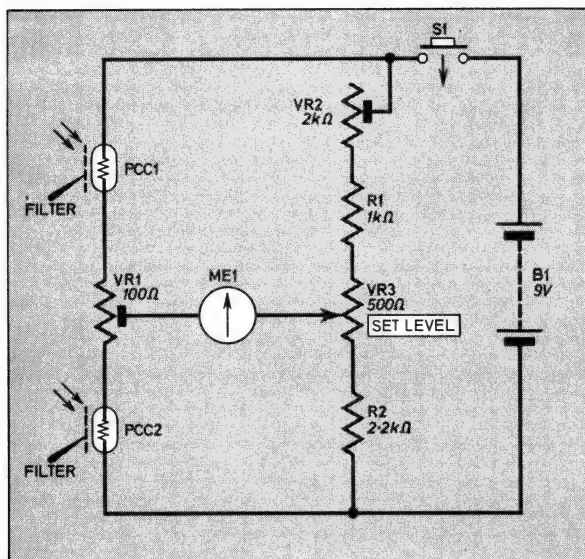


Fig. 2. Complete circuit diagram of the Photographic Colour Temperature Meter.

from a predominantly blue source will pass virtually unhindered through the blue filter to PCC1, but will be blocked by the PCC2 filter. Thus, with more light reaching PCC1, it will have a lower resistance than PCC2 and the voltage at the junction of PCC1 and PCC2 will rise, causing the meter pointer to deflect away from zero.

Much the same applies with red light, but here the meter pointer will deflect in the other direction as the voltage at the junction of PCC1 and PCC2 falls. Potentiometer VR1 is adjusted to bring the meter reading back to zero, and the change of colour temperature is given by the angular rotation of VR1 spindle.

CIRCUIT REFINEMENTS

The circuit of Fig. 1 would not work well in practice, for the following reasons. Sensors PCC1 and PCC2 would have to be perfectly matched if the instrument was not to respond to changes in light intensity as well as colour temperature, blue and red filters would have to be of known density and colour, and only a small centre portion of VR1 total track resistance would be usable.

In the complete circuit of the colour temperature meter Fig. 2, a low value potentiometer VR1 is inserted between PCC1 and PCC2 to eliminate l.d.r. resistance mismatch under high light intensities; this component also protects the sensors against an excessive current flow. In conditions of dim illumination, the resistance of the sensors can be equalised by masking one of them with a spot of ink or paint, as described later.

To simplify construction and reduce cost, the colour temperature meter uses simple blue and red filters made from several layers of coloured

cellophane (obtainable from most stationers), and VR2 is included in the circuit of Fig. 2 to correct individual filter variations and allow for circuit tolerances.

Calibrated potentiometer VR3 in Fig. 2 has a low track resistance in relation to the total resistance of the chain formed by VR2, R1, VR3 and R2, so that full use can be made of VR3 rotation to provide widely spaced calibration points.

CONSTRUCTION

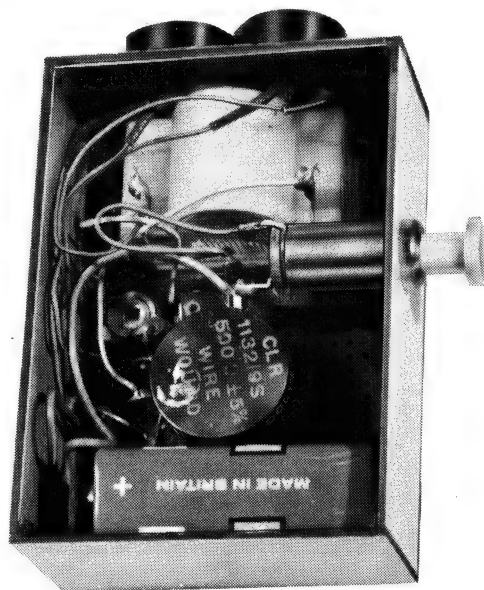
The case for the prototype was constructed from Formica, but almost any non-metallic case of suitable dimensions could be used. The case should be drilled to the dimensions given in Fig. 3 before any further construction is undertaken. Once the drilling is complete meter ME1 can be fixed as can the two l.d.r.'s.

The sensors PCC1 and PCC2 are housed in small, opaque cylinders made from plastic cigar holder stoppers or bottle tops, see Fig. 4. Each l.d.r. holder must be cut-down with a sharp knife to make the internal height equal to the height of the l.d.r., to ensure a wide-angle of light acceptance. Blue and red filters are fitted at a later stage. The l.d.r.'s are glued into the holders which are then glued to the case.

The preset potentiometers VR1 and VR2 are mounted on a piece of plain perforated s.r.b.p. board using mounting pins as indicated in Fig. 5. Potentiometer VR3 can then be mounted through a hole cut in the board and resistors R1 and R2 connected—one pin is used for R2. The board is then fixed inside the case using VR3 mounting.

Switch S1 can now be inserted through its

Photograph showing the inside of the Photographic Colour Temperature Meter.



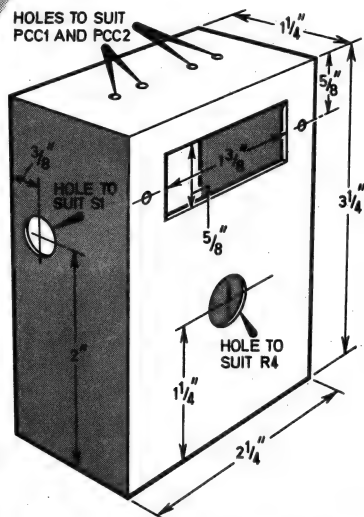


Fig. 3. Case drilling diagram.

Photographic Colour Temperature Meter



Fig. 6. Dial calibration.

Fig. 4. Details of the l.d.r. and filter mount.

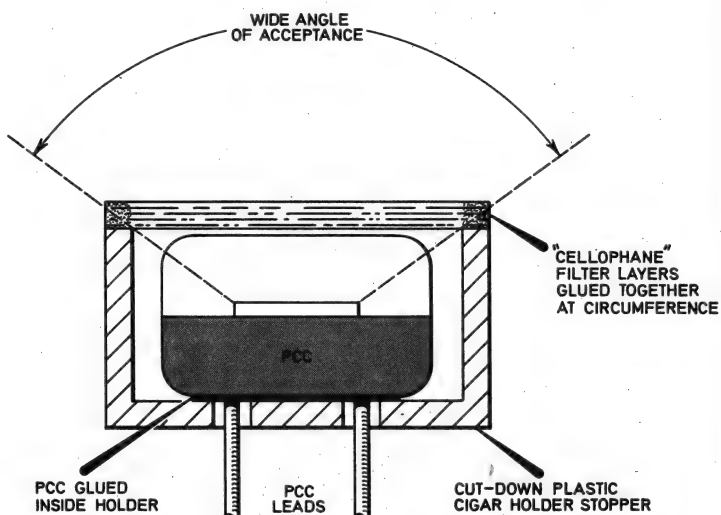
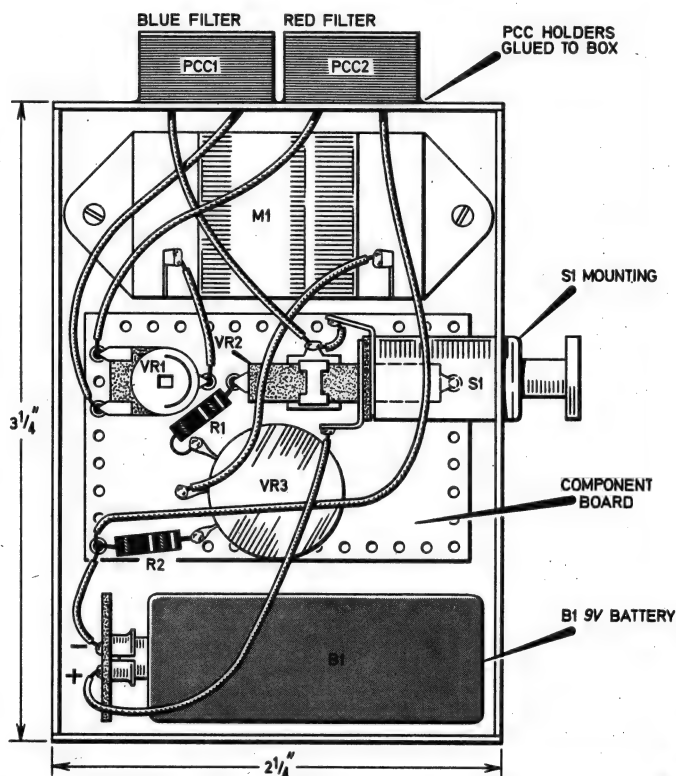


Fig. 5. Layout and wiring of the complete unit S1 is not mounted on the s.r.b.p. circuit board.



mounting hole and securely fixed. Finally, wire up the unit, as shown in Fig. 5, using p.v.c. covered stranded wire. Make sure to leave enough wire between S1 and VR2 wiper for adjustment of VR2. Connect the battery observing the correct polarity and the instrument is ready for setting up.

Apart from the need for both sensors to be placed side by side, as closely as possible, the instrument layout can be modified to suit individual requirements.

SETTING UP

Adjust VR1, VR2, and VR3 to the mid-track position. Place the colour temperature meter about 3 feet from a 100 watt pearl lamp, aligned so that PCC1 and PCC2 receive exactly the same amount of light. Press S1 and use the tip of a finger to find out which sensor needs masking to bring the pointer of ME1 to zero, then place a spot of ink or paint (black) on the face of the selected l.d.r. to achieve balance.

Next position the colour temperature meter with sensors almost in contact with the 100 watt bulb (maximum illumination), taking care that PCC1 and PCC2 receive the same amount of light. Adjust VR1 for zero balance.

The next stage is to prepare the red and blue filters, made from orange and pale blue (avoid mauve) cellophane respectively. Cut a paper disc to the outside diameter of the sensor holders. Fold orange and blue cellophane several times and cut out the filter discs with sharp scissors using the paper disc as a template. Glue four discs of blue cellophane on the PCC1 holder as shown in Fig. 3.

Take the colour temperature meter out of doors on an overcast day, well away from walls or trees. Set VR3 to the mid position and commence placing red filter discs over PCC2 until ME1 reads near zero when S1 is pressed. About twelve orange cellophane discs (red filter) will be required because the l.d.r. is more sensitive to red than blue light. The red filter discs can now be glued on the PCC2 holder, and the meter is ready for calibration.

CALIBRATION

In the absence of standard light sources, the following method of calibration is suggested. Make a temporary paper disc dial for VR3, with the scale shown in Fig. 5 lightly pencilled in. Set the pointer of VR3 at 2,800 degrees Kelvin and position the colour temperature meter a few inches from a 100 watt pearl bulb. With PCC1 and PCC2 equally illuminated, press S1 and adjust VR2 for zero balance.

For the next calibration check, choose a heavy overcast day, within an hour of noon, and set VR3 pointer to 8,350 degrees Kelvin in summer, 8,100 degrees Kelvin in spring or autumn, or 7,800 degrees Kelvin in winter. With sensors pointing straight up at the sky, press S1 and

observe the null meter. If the meter does not read zero, adjust VR3 for a null and mark the position of VR3 pointer on the paper disc dial. It should now be possible to gauge the discrepancy, if any, between the VR3 setting and the scale of Fig. 5.

If necessary, reposition the pointer knob on VR3 spindle and go through the above checks again for a new setting of VR2 until agreement is reached with the Fig. 5 scale. It is recommended that the temporary VR3 scale be left on the temperature meter for a few weeks so that various checks can be made, using Table 1 as a guide, and transparencies can be evaluated. When satisfied with results, a permanent scale can be made for VR3. A more accurate calibration technique is possible if several colour correction filters are available.

MIREN VALUES

Special correction filters may be placed in front of a camera lens to modify the colour temperature of light falling on the film. If the scene being photographed has a blue cast, a reddish filter of the right grade will give the transparency a normal colour balance. Correction filters are also used to achieve special effects, and to match a daylight type film to artificial light or vice versa. There is, however, a practical difficulty in selecting the right filter for the job. A given grade of filter will have a much greater effect at higher colour temperatures than at lower ones.

To make the process of filter selection simple, correction filters are graded in values based on the reciprocal of colour temperature, called the mired, see Fig. 5 and Table 2. A given grade of filter will always produce the same amount of correction anywhere on the mired scale.

Colour correction filters are identified by the letter R or B (standing for red or blue) followed by a number which is the filter rating in mireds divided by ten. For example, an R6 filter will make the colour of a light source more red by an amount corresponding to a shift of 60 mireds. Two filters placed together have an additive effect, a B6 plus a B12 will give a total shift towards blue of 180 mireds.

When the colour temperature meter has been roughly calibrated, it is a simple matter to interpolate between major calibration points with correction filters. Suppose that the colour temperature meter is reading the light from a 100 watt bulb with VR3 set to 2,800 degrees Kelvin (356 mireds), a B12 filter interposed between PCC1, PCC2, and the light source will raise the effective colour temperature by $356 - 120 \text{ mireds} = 4,240 \text{ degrees Kelvin}$, thus giving a fresh calibration point. With several filters, and a few known light sources, the whole colour temperature scale can be filled in by the above method.

USING THE METER

Since the object of the meter is to measure the colour of light sources only, avoid reflected light from brightly coloured objects, clothes, and green grass, etc.

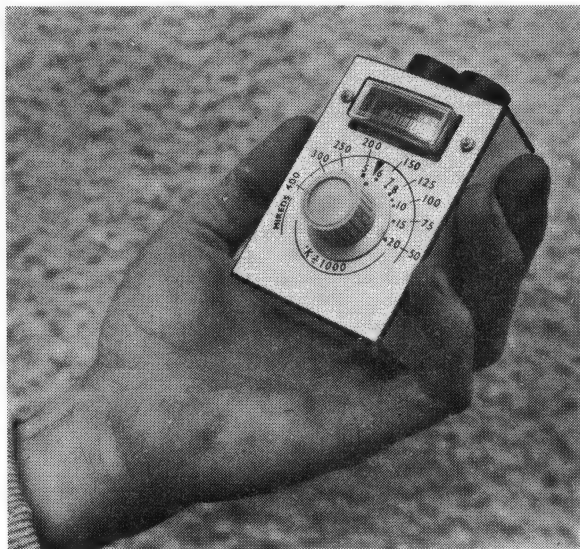
To take a shade reading out of doors, either stand in the shade of a neutral colour building with the meter pointing away from it towards the sky, or interpose the body between the meter and the sun. Always make sure that both sensors receive the same amount of light.

To measure the colour temperature of sunlight, the best method is to angle a sheet of white

paper towards the sun and take a reading from the paper. A similar method can be employed to take an integrated reading of mixed sunlight and skylight, by having the sheet of paper horizontal with the meter looking down at it. Alternatively, point the meter straight up at the sky with the sun illuminating both sensors evenly from front or back. □

Table 2: COLOUR TEMPERATURE AND MIREDS SCALES

Degrees Kelvin	Mireds
2,500	400
2,850	350
3,330	300
4,000	250
5,000	200
6,650	150
8,000	125
10,000	100
13,300	75
20,000	50

$$\text{Mireds} = \frac{1,000,000}{\text{degrees Kelvin}}$$


MEMORY STORE

by George Dunning

MY Father, like most of his contemporaries, had been during the late twenties an enthusiastic d.i.y. wireless constructor. Evidently, the radio we know was evolved on hundreds of breadboards in back kitchens—from delicate crystal sets through temperamental t.r.f.s with leaky grids to superhets with horn loudspeakers—by amateurs such as he.

One of my earliest recollections was of a great moment, when after much adjustment and careful tuning he summoned the whole household to the earphones. After a dramatic silence during which the phones were passed around, everybody joyfully agreed that it definitely was the sound of a violin and the earphone was held to my tiny ear to witness the historic event.

Not long after that, fairly reliable sets with cone speakers appeared on the market: the enthusiasm for wireless construction waned and the whole paraphernalia was retired to the shed.

Many years later in a dark corner I discovered a large toroidal

coil and on blowing the dust from its label I read "What are the wild waves saying?" My curiosity was aroused and I asked the inevitable question: "How does wireless work, Dad?" His answer was curt and final; "You've no time to fiddle about with that, lad while there's studies to attend to". It remained a mystery—a thing I dismissed from my mind so that in time I not only did not know, but I did not want to know about things electronic; they were not my line of country.

And so it remained until the mid fifties. At that time I was working as a routine chemist and I began to notice how the advent of electronics enabled automatic physical methods to cut out some of the lengthy analytical chemical methods. It became increasingly clear that my livelihood would eventually be threatened and so, in short, I decided that as I could not beat them then I must join them. Accordingly I enrolled for evening classes in Telecommunications.

Thus I entered the world of electronics comparatively late in life. The wireless theory I acquired led me naturally via journals such as *Practical Wireless* and later

Practical Electronics to the fascinating hobby of electronic gadgetry. No elaborate workshop was needed. Armed with a multi-range meter, a soldering iron and a pair of strippers most projects could be tackled on the kitchen table.

For me the fascination lies in innovation. I cannot ever remember having copied a constructional item, component by component. My projects are usually a hotch-potch of several past constructional features and ideas arranged so as to exploit some component new to the amateur market: a thyristor replacing a relay, an i.c. replacing both vibrator and amplifier together. The excitement comes in finding out if it will work.

Looking back, I would say that by learning the theory first I gained greater pleasure and was able to build more efficiently sooner—but it was by no means essential to efficient construction. With only a knowledge of Ohm's Law and a healthy respect for Finnigan's Law anyone at any time can jump in at the deep end and soon be swimming around with those hitherto strange fish; the amateur constructors.

USING THE METER

Since the object of the meter is to measure the colour of light sources only, avoid reflected light from brightly coloured objects, clothes, and green grass, etc.

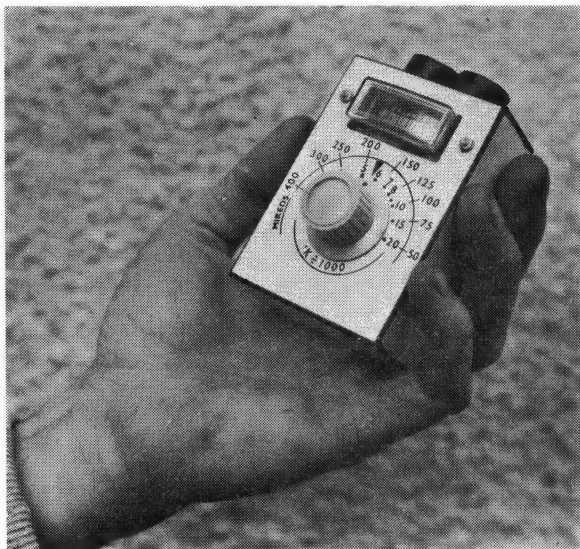
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UNFORTUNATELY we have to write the copy for Shop Talk before the previous issue is on sale and hence no "feedback" from you, the readers, is available to tell us if indeed we did solve all your buying problems. However, if any general buying points do arise from various articles we should be able to deal with them in the following issue.

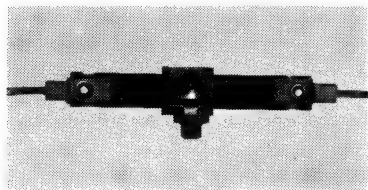
Having had a few phone calls concerning R.S. Components arising from another source it is possibly worthwhile reinforcing what was said last month, and also to mention that one or two firms are now specialising in R.S. Components parts and a look at adverts at the back may be advantageous.

After looking through the components lists this month it would appear that nearly all the components are readily available.

Photographic Colour Temperature Meter

The slider preset potentiometer may not be easy to get for the *Colour Temperature Meter*, other types could be used but the slider fits in well. Some of the London shops should be able to help if your supplier cannot. The push button used by the author will probably not be obtainable but any "press for on" push button that is not too big should be all right; there are a number generally available.

The original case looks very neat and is made of white Formica, held together with Araldite.



Fuzz Box

Well, the *Fuzz Box* should be straightforward as far as buying goes. Once again the author's case looks neat and is both strong and inexpensive.

Demo Deck

Take note of the piece about RS Components above and you should have few problems in buying for the *Demo Deck*. Strangely enough, the only real buying problem Mike Hughes had was in



obtaining the 0.06 amp (60 milli-amp) bulbs. If you cannot get them Home Radio are the people to write to.

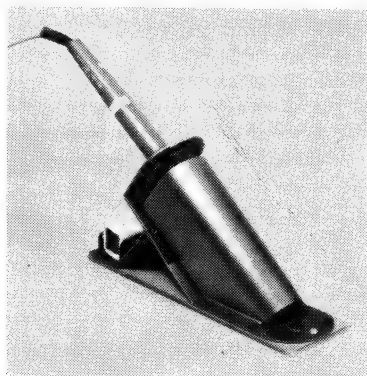
Our *Demo Deck* cabinet was made by a professional from Afrormosia Mahogany and looks very presentable. Obviously, many people could not make up such a good cabinet but our design is recommended as it has facilities for all the necessary bits and pieces.

Teach-In

If you have any problems buying those few resistors for next month's *Teach-In*, you are just not trying. If you get 5 per cent types so much the better, they will probably not cost any more.

New Products

To protect your hands, clothing, the kitchen table and even carpets, a soldering iron stand is a must. You should never hang your iron on equipment or the edge of a table as it is all too easy



to reach across it and burn a hole in your clothing or skin.

If you have an area where you can set up a permanent work bench then buy a good stand and screw it to a bench. If you have to move around or use "borrowed space" then buy a good free-standing iron stand. This will help when you clear the work area as you can move the iron in the stand without having to wait or it to cool.

There are many stands available and most iron manufacturers make a stand for their irons. One universal one that was sent to us some time ago is shown in use with an Adcola Invader Iron left. This stand is well constructed and is available as a free standing or bench mounted type, and will take any iron with an element diameter less than $\frac{1}{2}$ inch. It is attractively finished in red anodised aluminium, with a tip cleaning pad, made by Stangard and is available from Home Radio (Components) Ltd., for £1.33 (bench mounted) or £1.83 (free standing as shown).



Bradewick is a sort of "solder sucker," it is designed to remove solder from joints being desoldered. This should prove useful when working on the *Demo Deck* as it will prevent those large blobs of solder from building up around the tag posts.

To desolder a joint, simply apply the wick simultaneously with a soldering iron, the wick will soak up the solder as it melts. The solder-filled part of the wick can then be cut off.

Bradewick is available in four width sizes from 0.025 inch to 0.1 inch, the 0.075 inch sizes (Green Label) should suit most constructors. Available from Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, CR9 2LL, or retail shops, the cost is 90p for approximately five feet of any width.

Windscreen Wiper Control

Part Two
By S.B. Squire

LAST month we showed how the unit can be fitted to cars with single speed field coil motors however, some cars are fitted with two speed wipers using a field coil motor, the wiring diagram for these motors is shown in Fig. 6a, Fig. 6b shows how the unit is wired to this system. If required the unit may be used to operate the wipers at either of the two speeds depending on the wiper switch position (1 or 2) that the yellow wire from RLA1 is connected to. Wiring shown in Fig. 6b is for positive earth, reverse X and Y for negative earth systems. The green wire is not used and need not be fitted.

PERMANENT MAGNET MOTORS

During the last few years permanent magnet wiper motors have been fitted to many cars and these motors are wired up as shown in Fig. 7a. You will notice that the parking switch shorts out the motor when it is turned off. This is so that the motor stops quickly. Most cars fitted with permanent magnet wiper motors are wired negative earth and Fig. 7b shows how the unit

is wired to such a system. Notice that the wire between the wiper switch and the parking switch is broken and the normally closed side of the set of changeover relay contacts inserted in this line (green and blue wires from RLA1).

The normally open contact (yellow wire from RLA1) is wired to the other side of the wiper switch. The blue wire must be wired to the wiper switch—the non earth side.

If your car has a permanent magnet motor and is wired for positive earth, simply reverse wires X and Y shown in Fig. 7b.

The fourth and final system is the two-speed permanent magnet type, again usually wired for negative earth. It is possible to use this unit with these motors but only on the first switched speed, reference to Fig. 8a will show the car wiring normally used with such a motor and Fig. 8b shows how to wire the unit to the motor, note that the normally closed side of the change-over contacts are wired between the wiper switch and the parking switch (blue and green wires from RLA1) while the third—normally open contact (yellow wire from RLA1) is wired

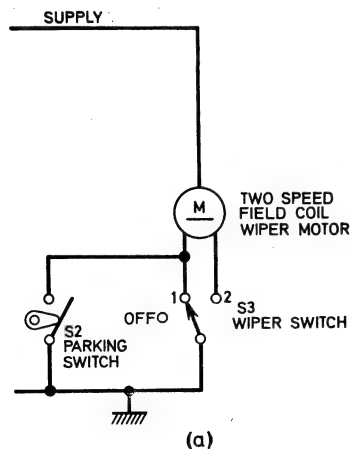


Fig. 6a. Wiring diagram for a two speed field coil wiper motor.

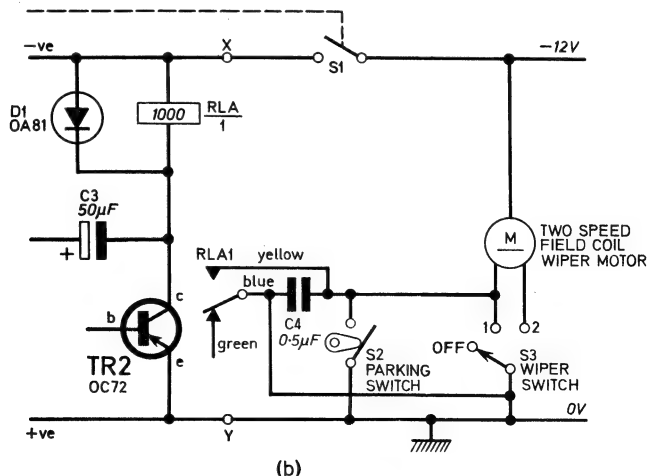


Fig. 6b. Showing how the unit is wired to a two speed field coil system—positive earth shown. In this configuration either speed can be used depending on which wiper switch position the yellow wire is connected to.

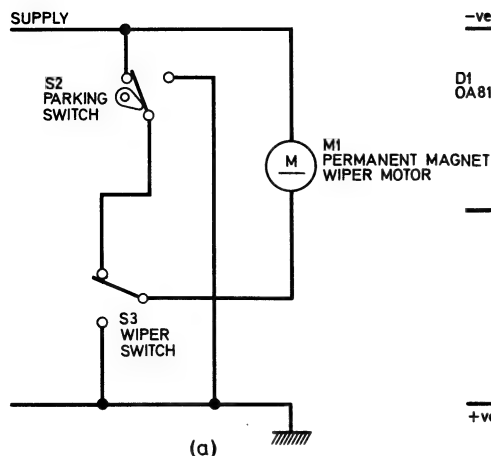


Fig. 7a. Wiring diagram of a three wire permanent magnet wiper motor.

to earth. The centre contact (blue) must be connected to the wiper switch as shown.

If your car has a positive earth two-speed permanent magnet motor simply reverse wires X and Y.

IDENTIFYING THE CAR WIRING

You should be able to determine the type of motor used in your car from the number of connecting wires on the switch, i.e., 2 wires (single speed)—field coil; 3 wires (two-speed)—field coil dual speed; 3 wires (single speed)—permanent magnet; 4 wires (two-speed)—permanent magnet. It should be possible to obtain a wiring diagram and find out which colour wires go where and how the various switches are wired up, but if this is not possible then you

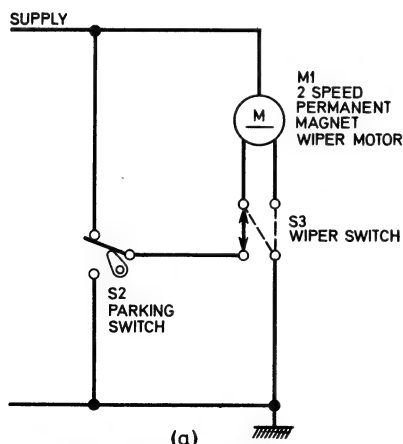


Fig. 8a. Wiring diagram for a two speed permanent magnet wiper motor.

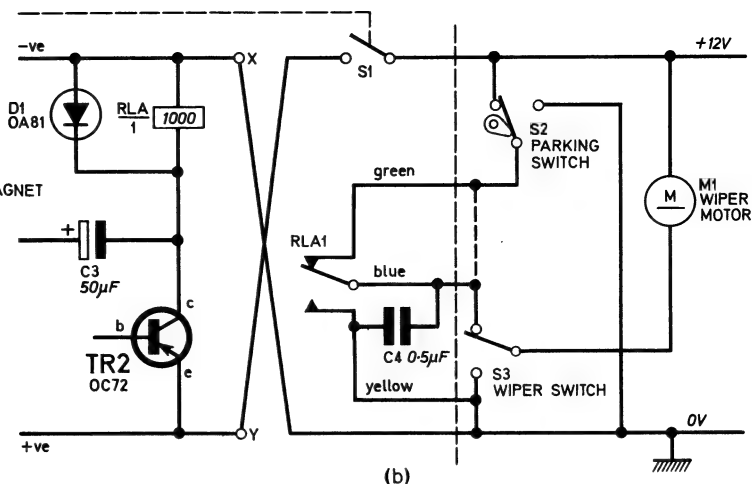


Fig. 7b. Showing how the unit is wired to be used with a permanent magnet motor. Note that the wire between the wiper switch and the parking switch has to be disconnected, and the relay contacts wired in. Negative earth system shown.

will have to trace the wires on the car to find out how to wire in your controller.

OPERATION

Once the unit is fitted to the car it is operated without touching the normal wiper switch. With the wipers off, switching on the unit will give one wiper sweep (back to the park position) approximately every five seconds. Further rotation of the control knob will increase the time interval between sweeps up to approximately 25 seconds. The 0 to 10 scale on the knob can be used as a guide to the delay time.

For normal operation of the wipers simply switch off the unit and turn on the wiper switch. in the normal way. ■

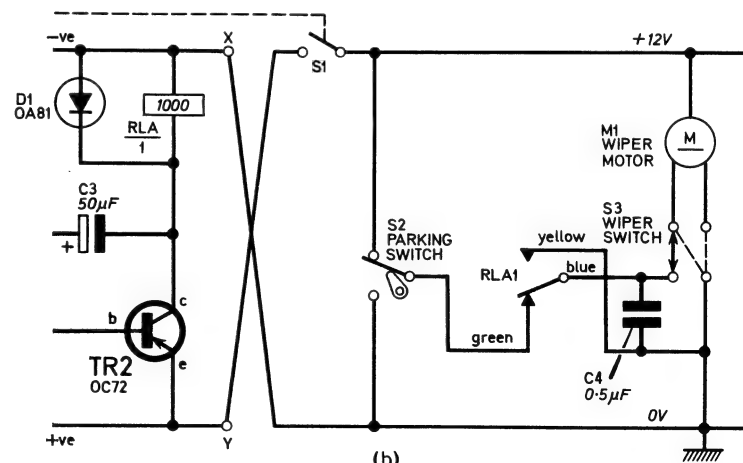
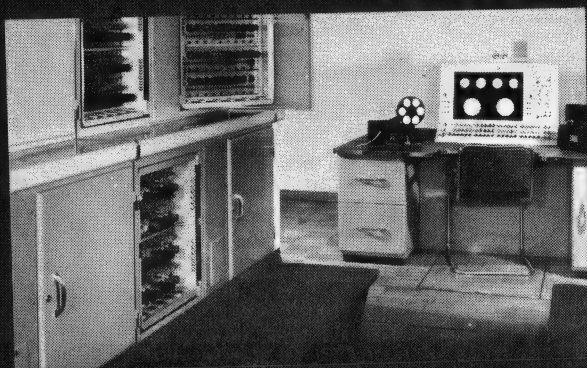
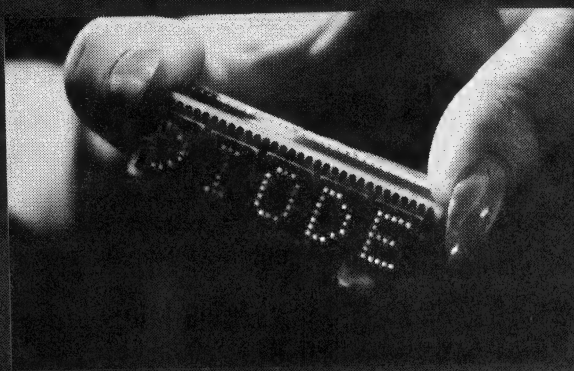
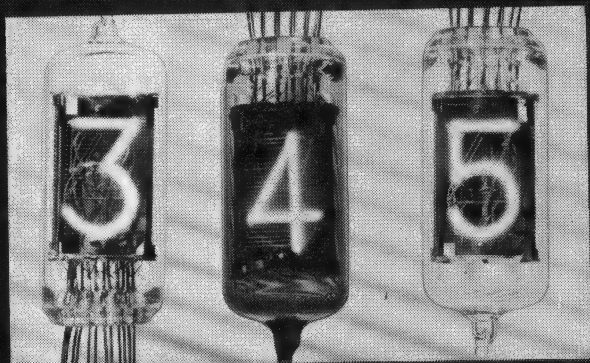


Fig. 8b. Showing how the unit is wired for a two speed permanent magnet wiper motor. Note that the wire between the motor and the first switch position must be disconnected and the relay contacts wired in. Negative earth system shown.

electronics



PAST & PRESENT

By Prof. G.D. Sims, OBE, PhD *(Southampton University)*

The second half of our story opens with the introduction of integrated circuits—and the beginning of microelectronics. Some of the significant new applications that have already emerged as a result of technological developments are mentioned, and finally, some likely prospects for the future are discussed.

Top left: Cold cathode neon filled numerical indicator tubes. Such devices are used in electronic measuring and computing equipment to provide visual readout of data *(Mullard)*

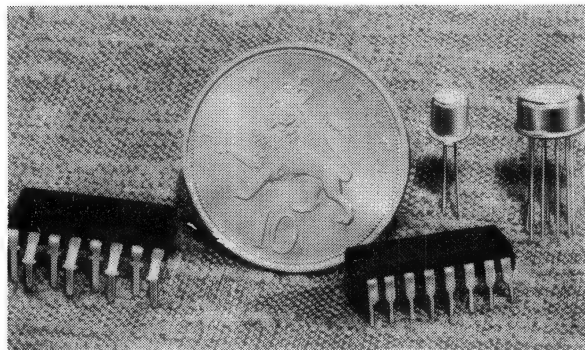
Bottom left: Ferranti Mark I Computer at Manchester University 1951. This was the first British electronic computer. It employed 3,000 valves, and a refrigeration system; cathode ray tubes were used as data stores, in addition there was a magnetic store. This picture shows just part of the computer, the central processor and the control desk *(Ferranti)*

Top right: Small size solid state display made up from a matrix of tiny gallium arsenide phosphide light-emitting diodes. Can be arranged to provide numbers or words of any length *(Marconi)*

Bottom right: The latest Ferranti Computer, Argus 500, is a fast computer system for on-line applications. The central processor, the sub-unit at extreme left of picture, can operate with one microsecond core stores. Compare this small sub-unit with the large cabinets required to house the central processor of the Mark I *(Ferranti)*

THE success of microelectronics as we know it today stems largely from the exploitation of the silicon planar process. A typical integrated circuit may contain a number of transistors, resistors and capacitors all made within the same silicon "chip" the interconnection pattern between them being evaporated on after all of the components have been formed. "Large scale integrated circuits" can contain thousands of devices all made in the same piece of silicon.

The majority of integrated circuits commercially available at the present day, however, are the simpler ones and these alone open up a host of new possibilities in electronic design for both professional and amateur alike.



Integrated circuits for colour television. From left to right: colour demodulator, central signal processor, voltage reference source, and inter-carrier sound i.f. and detector (Mullard)

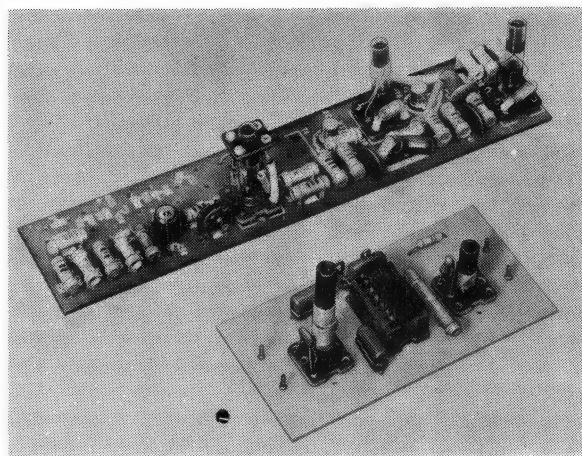
LINEAR INTEGRATED CIRCUITS

Whereas at one time the task of wiring up separate components to form an amplifier was "bread and butter" to the engineer, it is now often possible to buy a suitable amplifier integrated in a single chip and ready for use. "Linear" integrated circuits (such as amplifiers) are commonly available in a variety of forms and can be regarded as the design blocks of our future systems in much the same way that the transistor, and earlier still the valve, were in the past.

DIGITAL INTEGRATED CIRCUITS

Integrated circuits, however, have come to be most widely used in "digital" (pulse) applications such as those involved, for example, in the design of the computers to which we have referred.

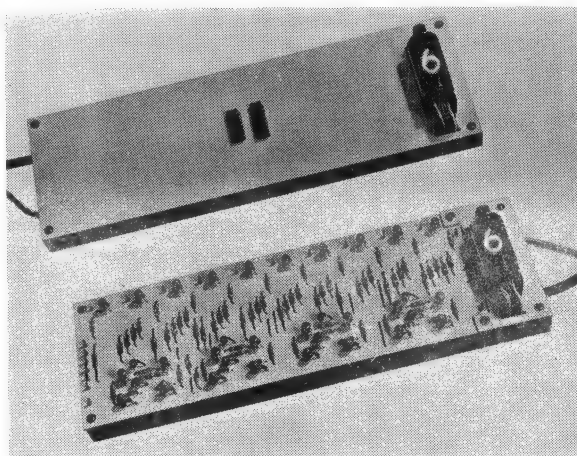
We have already drawn attention to the fact that electronic circuits can make yes/no decisions and hence "think". The design of "thinking" systems therefore is very much concerned with the design of "logical systems", which perform deductive tasks in much the same way that a human being does. It is this link with logic which has given impetus to much of the digital integrated circuit development.



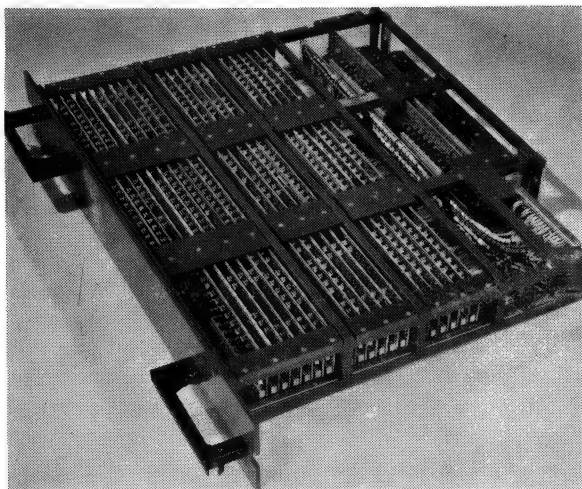
Contrast between the conventional "discrete component" version of a colour receiver i.f. amplifier, and one incorporating a linear integrated circuit (Mullard)

Many "families" of such integrated circuits are available, each forming a comprehensive range of logical functions and some of these are now extremely cheap to buy. In many other applications besides computing, for example in control systems and in communications, it is better to design in terms of digital building blocks rather than around the linear circuits traditionally used; and many future developments, of increasing interest to amateurs, will centre around the uses of these digital modules.

The microcircuit therefore is the key to our future. Let us look at the advances which electronics has made possible in recent years and at the same time some of the problems which lie ahead.



Decade counter using two digital integrated circuits (top) compared with a similar device using discrete components (Mullard)



The central processor of the Argus 500 Computer. This unit incorporates 980 integrated circuits and 220 discrete semi-conductor devices; and is 30in. high, 22 deep and 5in. wide (Ferranti)

MAN/MACHINE PROBLEMS

One area which is currently exciting great interest is the man/machine interface problem, coupled with the question of how can we replace human functions by electronic systems?

At the present time electronic systems exist which can learn fairly satisfactorily to read even handwriting, though as yet they are far from being sufficiently perfect for use, for example, in letter or parcel sorting. However, if standard alphabets are used the possibility of such tasks as stock control being performed by machines which scan invoices and ultimately, perhaps, even audit books, seems to be within the realms of the possible.

A related problem is concerned with the identification and artificial production of those

attributes of sounds which characterise speech. Clearly knowledge of this kind is vital also to the elimination of those characteristics which produce discomfort in human beings and to the alleviation of noise pollution generally.

Similar techniques to those used in this field of "pattern recognition" can also be used in medical diagnosis to compare patient information with that of previous cases in order to predict appropriate methods of treatment.

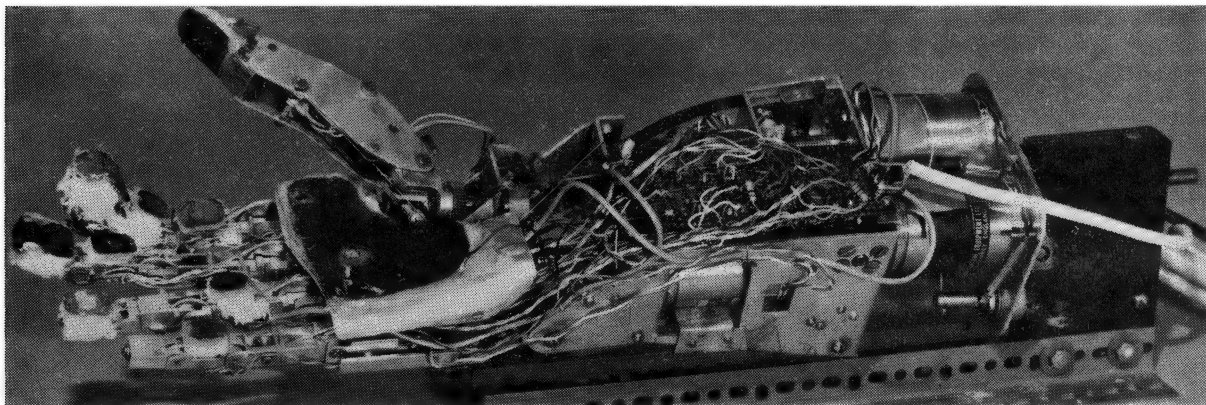
All of these applications depend upon suitable electronic circuits which will recognise, classify, identify and compare, symbols, signals or noises, and it is only with the coming of cheap electronics that such systems—previously regarded as being too expensive or too complicated to make—are now possible.

ELECTRONICS AND "MEDICINE"

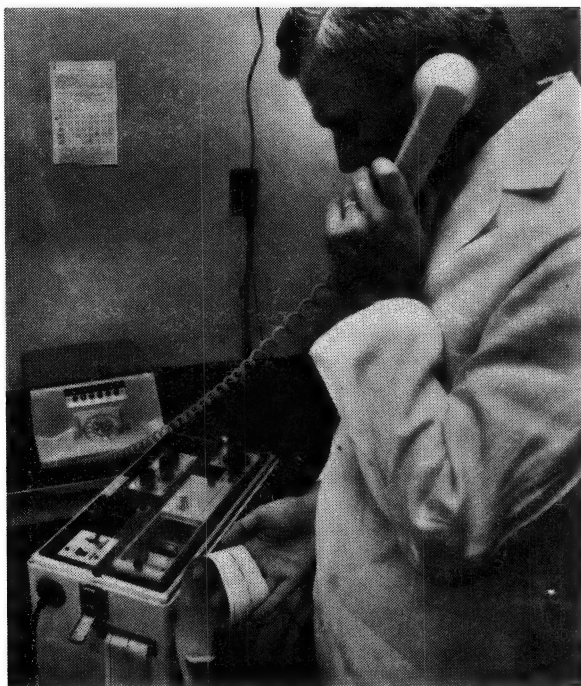
Mention of the medical field touches upon one of those areas where electronics has now started to make very significant contributions; we can for example now produce an artificial hand so sensitive that it can pick up fragile objects without crushing them and so positive that it can hold objects tightly, merely when the human mind controlling the hand thinks that it wishes to perform one or other of these functions. Such a hand is actuated by signals from nerve endings in the body and will imitate any movement which a natural hand would have performed.

Further development is still needed before such aids find general application as certain electromechanical problems still exist, but the pure electronics, which interprets the nerve signals and controls the hand motion, can now be reduced to a volume and weight compatible with a normal limb size: all of this thanks to the development of microelectronic techniques.

A related application also envisages the use of



Prototype model of adaptive artificial hand. It is driven by six compact d.c. permanent magnet motors and contains about thirty transducers. These provide the control system with detailed information about the object being grasped such as its shape, position and stability; they also monitor the forces, velocities and positions of the digits. This experimental device weighs twice as much as its human counterpart. Commands for the control system are derived from myoelectric signals produced by the operator (Dept. of E.E., Southampton University)



Diagnosis by Computer. This heart specialist in the United States uses an electronic telephone to transmit a patient's heart record from this electrocardiograph to a computer. The computer will analyze the signals and return a diagnosis in about two minutes (*U.S. Information Service*)

microelectric techniques to produce feedback signals to control nervous or spasm conditions, or to make up for damage to the nerve paths, which act as the normal communication channels between the brain and limbs, such as might be associated with some forms of paralysis. A whole family of related devices, which is now coming under consideration, involves such items as talking aids for those with speech defects, or typing aids for those who have lost the use of limbs.

A voice operated typewriter, actuated by spoken signals in the form of a kind of morse code, can now be made and the possibilities which this kind of device opens up are tremendous. One could, for example, now envisage a small computer making its time available to a range of aids of this type, enabling a complete office or workshop to be manned by people who were disabled in one way or another.

The fact that electronics could now offer employment possibilities to the handicapped is both important and exciting and could not have been contemplated a few years ago. In this area, however, we are only just at the beginning of the road.

AUTOMATED DESIGN AND PRODUCTION

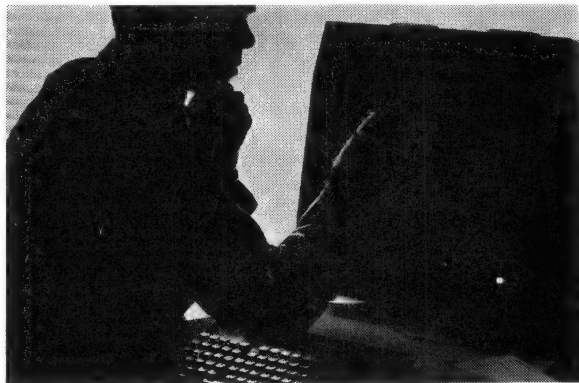
Many other previously manually executed jobs

of course are now already performed by special purpose computer systems. For example, electronic control of machine tools is finding increasing use in industry.

In this case the operator specifies to the control system just what shape the machine is to cut—he does this by way of data on punched tape or cards—and the machine proceeds to produce the work automatically with little need for human intervention.

Further back in the design chain, newly developed electronic draughting machines are also rapidly gaining acceptance. Production of, for example, a radar system may require as many as 20,000 detail drawings, which such a machine, suitably programmed, can produce on command from basic master sketches.

Initially the master is produced from data typed into the machine while other parts of the sketch are drawn in using a light pen controlled by the "draughtsman". Amendments can also be



Designer in dialogue with computer. A senior designer is shown adding another stage to the MOS microcircuit which he is designing in co-operation with a Myriad computer. He is using a light pen to put a new section into the main circuit design, having called it from the computer store using the keyboard. (*Marconi*)

made via the light pen and the drawings can thus be amended and up-dated when necessary.

Similar computer based design techniques are used in the production of large scale computer systems themselves where the back wiring diagrams are both devised and produced by computers: the same is true of the printed circuit boards on which the components and individual microcircuits are housed. The computer can lay out these boards in an optimum way and what was once a very tedious and time consuming human operation has now been reduced to a straightforward programming exercise.

COMPUTER AIDED DESIGN

Computer aided draughting to which we have just referred should not be confused with "Computer Aided Design" (C.A.D.), which is attracting

excited interest in all branches of the engineering industry.

In the electronics field, circuit diagrams and systems specifications can be fed into a computer which will in turn calculate all the component values to meet the specification. Before the electronic system is actually built, the machine will simulate any design arrived at, see if it is perfect and in some cases can even lay out the various masks needed to produce microcircuits of which the system will ultimately be built.

Clearly techniques of this kind are unnecessary with simple circuits and systems such as the amateur would need to deal with, but the complexity of many of the things the professional electronic engineer is now called upon to produce is such that only with aids of this kind can he complete his assignment in a realistically short time—if at all.

Present limitations of C.A.D. depend mainly upon the size of the computer needed to deal with really ambitious systems, and on the ability of those engaged in semiconductor device research to produce suitable "models" of their device behaviour from which the computer can work. Such limitations apart, however, it is in principle possible for the computer to design an electronic system right from the initial circuit diagram through to the digital information which will control the making of the masks used to produce the component microcircuits of which the system will ultimately be built. Many of these processes are still in the research stage, but the days of at least partly automated circuit production are rapidly drawing nearer.

In other fields of engineering, C.A.D. techniques are used to produce minimum cost systems, for example, in an electricity supply system optimum sizes and kinds of components can be chosen by the computer, using linear programming techniques, to perform within given safety factors any specified function.

MODERN COMMUNICATIONS

In communications, with the advance of digital techniques, (for example, pulse code modulation) microelectronics has again found a natural home and the electronic telephone exchanges of the future will be realised in very different form from those currently installed, as increasing degrees of circuit integration are incorporated.

Problems of signal storage still remain, though acoustic techniques, ferromagnetic bubble storage and more particularly the recent improvements in M.O.S. technology offer hopes of early progress on this front too.

In the field of signal transmission, waveguide techniques have now been developed to the point where they offer advantages in some situations over cable or microwave links. Indeed the Post Office is currently installing a 16 kilometre experimental run of multimode helical waveguide, which is due to be incorporated into



This 50mm helical waveguide, seen at the Post Office research station Martlesham Heath, can carry several millions of voice channels (The Post Office)

regular communications use in 1973.

A single 50mm helical waveguide can accommodate several millions of voice channels and though these techniques have been in prospect for several decades, it is only recently that the major difficulties have been resolved and the system has become economic. Trunk waveguide systems may well form the future transmission medium on some of the world's busiest communication routes, for the bandwidth available to us for free space microlinks is rapidly being used up.

Until recently, even given that the waveguide system itself had presented no problems, the terminal equipment to decode the signals and separate the individual channels would have been formidably complicated, without the electronic sophistication available to us today.

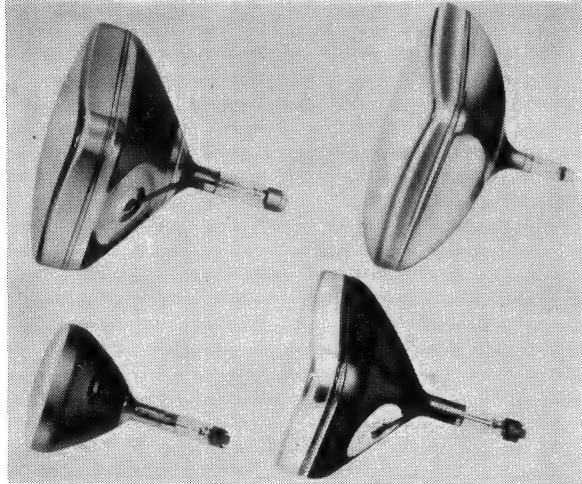
OPTO-ELECTRONICS

What else is in store? We are steadily approaching a new age in which light producing devices offer increasing possibilities as a means of conveying information. New electronic light sources and detectors together with low-loss optical fibres enable us to conduct light round corners and such techniques on a small scale enable the surgeon, for example, to investigate the interior of his patient using illuminated mirrors at the end of a fibre light guide.

In years to come fibres could well serve as a

long- as well as a short-distance communication medium offering even greater bandwidth than that which is offered by the waveguide techniques mentioned previously.

We have seen already that there is good reason to dispense with devices depending upon free electrons (as in the old thermionic valves) wherever possible in favour of solid state devices. There are two areas where we have not succeeded; one is in the design of high power



Development of television picture tubes since 1945: (lower left) 9in., 14.6in. front to back; (lower right) 14in., 16.6in., (top left) 17in., 15.6in; (top right) 19in., 12in. (Mullard)



The television screen of the future? A new type of display panel using a special "liquid crystal" material is currently under development. Words or other information appear on it when a low voltage is supplied by wires which are concealed in this photograph. Immediate practical uses are likely to be data readouts for control panels, animated labelling for keyboards, and see-through map displays which pilots and drivers can read "head-up" without losing sight of the view ahead. One day, "liquid crystals" might provide television screens thin enough to hang on a wall (Marconi)

transmitting valves where the electron tube still reigns supreme; the other is in the display field where the cathode ray tube also remains unchallenged.

Yet, once again much research is directed towards finding solid state replacements for these devices, enabling us prospectively to get rid of high voltages, hot cathodes and relatively short lifetimes. The day of the all solid state camera tube and the solid state display cannot be far away!

RETROSPECT

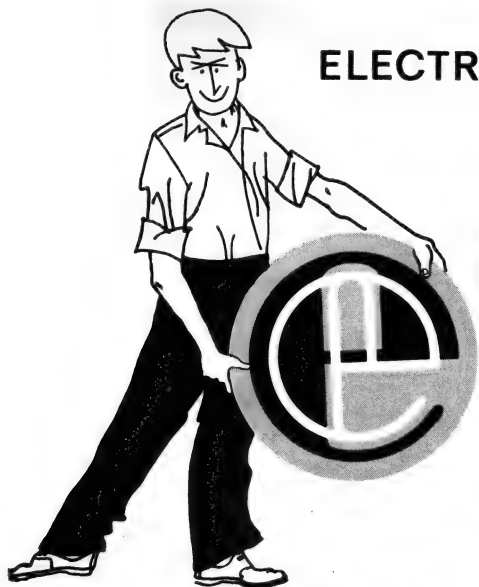
The pace of this advance has been breathtaking and the rapidity with which we have accommodated it equally so. We take for granted already the computers which process our bank cheques, we take for granted the information which is transmitted back to earth from weather satellites and indeed the fact that we can now receive television pictures from, for example, Japan whereas at one time the only way of doing this was to send a film round the world by aircraft.

We take for granted the safety of the navigational systems in the aircraft in which we fly, that the radio altimeter will tell the pilot the correct height when he is coming in to land, or indeed, even more so, that the automatic landing system will handle the aircraft and not miscalculate the point at which it is supposed to meet the ground! We fail to notice the increasing reliability of our telephone system, of which we are perhaps even less conscious when things go wrong!

All of these developments have occurred within the last fifty years, some within the last fifteen, and because of them and more particularly through our television sets we all know far more about the other countries of the world and their peoples than previous generations could have dreamed of. We have all become accustomed to, and indeed have come to expect, ease of communication and travel in all senses. The social effects of these developments all due to electronics have already been immense even if their source has not always been generally recognised.

It may be, as some have suggested, that the era of rapid developments in electronics is now passing and that as we move into the future the progress will be less spectacular. Past experience teaches one to treat such predictions with caution—though, true or not, we may be assured that the demand for electronics equipment and the need for people who understand how to design it will continue.

With the development of simple, easy to use circuits more and more people will find in electronics a diverting pastime which they can put to useful purposes. The main developments may be behind us but the future nevertheless remains tremendously exciting! □



ELECTRONIC CIRCUITS - IN THEORY and PRACTICE

TEACH-IN ... FOR BEGINNERS

By Mike Hughes M.A.

2 ELECTRIC CURRENT

THE trouble with an electric current is that you cannot see it. Perhaps this simple fact is the main reason why a mystique has built up about electronics. Once you have a grasp of what causes an electric current to flow then a lot of basic electronics can be understood right away.

CURRENT FLOW

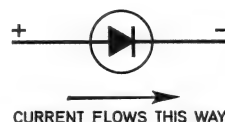
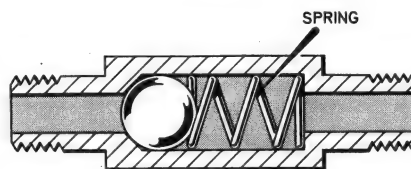
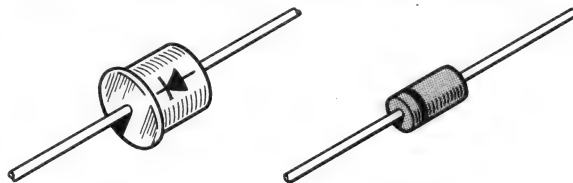
We all take for granted that we can connect a bulb to a battery and make the bulb light up—this is because an electric current flows through the bulb.

How can we prove that current is “flowing”? To have a flow we must pre-suppose that the flow is in one direction only, like a stream. We can show that there is a directional property to current flow very simply but we will need three components: a 9 volt battery, a 9 volt bulb in a lamp holder, and an electronic component called a diode.

We shall be talking about diodes later so at this stage let us consider it simply as a one way valve to the flow of electric current. If you wish to buy a diode capable of doing this experiment you should ask for one having a forward current of 1 amp and a working voltage of at least 12 volts. There are many types to choose from—perhaps the most common having type numbers 1N4001, 1N4002, 1N4003, 1N4004 (the 1N4001 should be the cheapest because it has the lowest working voltage). Fig. 1 shows the appearance of some common diodes that will do. Note there are two wires and either an arrow shaped symbol pointing along the device or a spot or band around one end.

The 1N4001 has a band which corresponds to the end to which the arrow symbol is pointing. This arrow is pointing in the direction along which the diode will allow electric current to flow.

Fig. 1. Two common diode encapsulations are shown above a ball-valve which represents a diode. Water can flow from left to right but not from right to left, likewise a diode allows electric current to flow only in the direction of the arrow in the symbol (shown below the ball valve). This assumes that current flows from positive to negative.



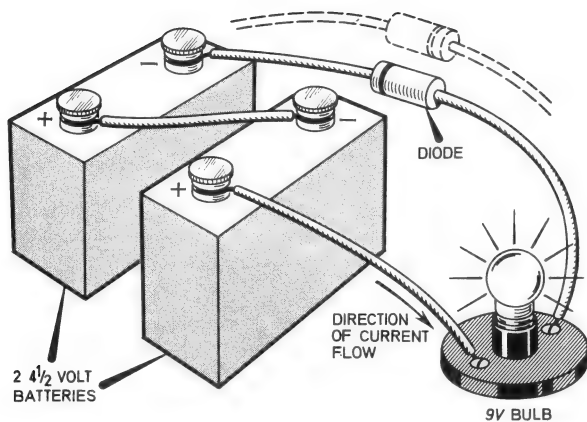


Fig. 2. The bulb lights with the diode connected as shown but will not light if the diode is reversed as in the broken line drawing.

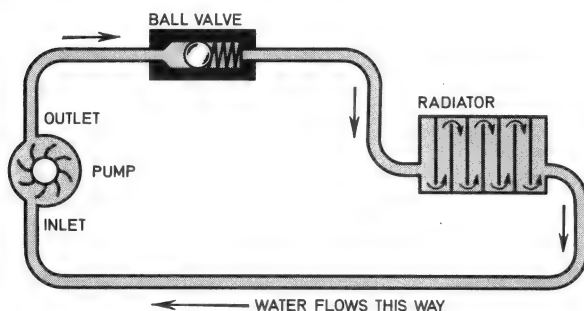


Fig. 3. Water analogy of Fig. 2.

Connect the lamp to the battery with two wires and see that the lamp lights. Reverse the leads to the battery: the lamp still lights. Now put the diode in the circuit. Connect the banded end of the diode (arrow head end) to the *negative* terminal of the battery; the other end to the bulb; the other side of the bulb to the *positive* terminal (we say that the battery, bulb and diode are connected in series). The lamp lights again. Now reverse the diode in the circuit so that the banded end is pointing towards the bulb. The lamp does not light because the diode does not allow current to flow through it this way round (Fig. 2).

By referring to the way the diode was connected in the circuit we can decide which way the current was flowing. It was, in fact, from the positive terminal through the bulb and diode into the negative terminal. This simple circuit has a nice analogy if we consider water as electricity, a pump as our battery (producing pressure) a spring loaded ball valve as our diode, and a radiator as the lamp (Fig. 3).

DEFINITION

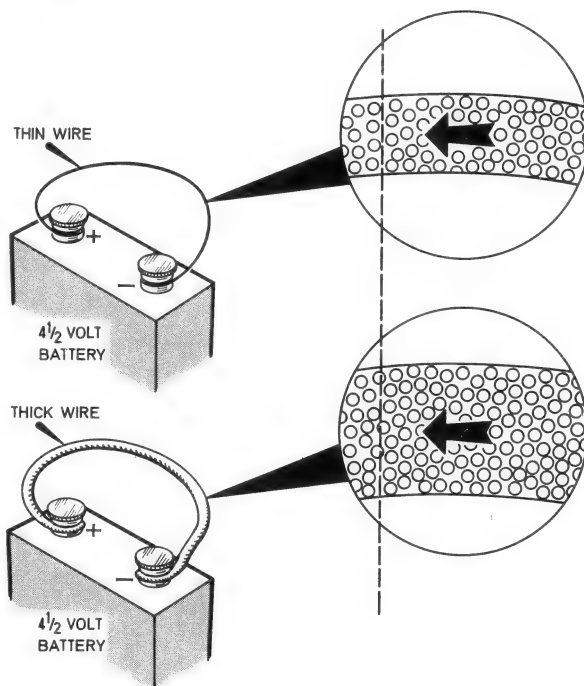
We shall return to this analogy shortly but first let us simply describe what constitutes an electric current. It is quite simply the transfer

of energy from one place to another, the energy being transmitted by the movement of minute particles of matter called electrons. These electrons have a negative charge and like north and south poles of a magnet the negatively charged electrons are attracted to positive potential (voltage)—they are repelled by a negative voltage.

Every material has a number of free electrons within it; copper has a great many and hence is capable of carrying more electric current (for a given cross section) than most other materials—we call it a good conductor. Glass has very few free electrons and hence we call it a bad conductor (or an insulator).

If a piece of copper wire connects the positive terminal to the negative terminal of our battery (do not do this in practice because you will run the battery down) we can imagine the free electrons in the copper moving from the negative terminal to the positive. Note that here is an ambiguity; although electrons move from negative to positive we say (by definition passed down through the ages) that current flows from positive to negative. This sounds confusing but does not usually cause many headaches and because it is such a ridiculous ambiguity it is easy to remember. Unfortunately the definition cannot be changed easily because all the rules of electromagnetism are based on it. During the series we will always assume that conventional current flows from positive to negative.

Fig. 4. More electrons move pass the dotted line per second with a thick wire than do with a thin wire.



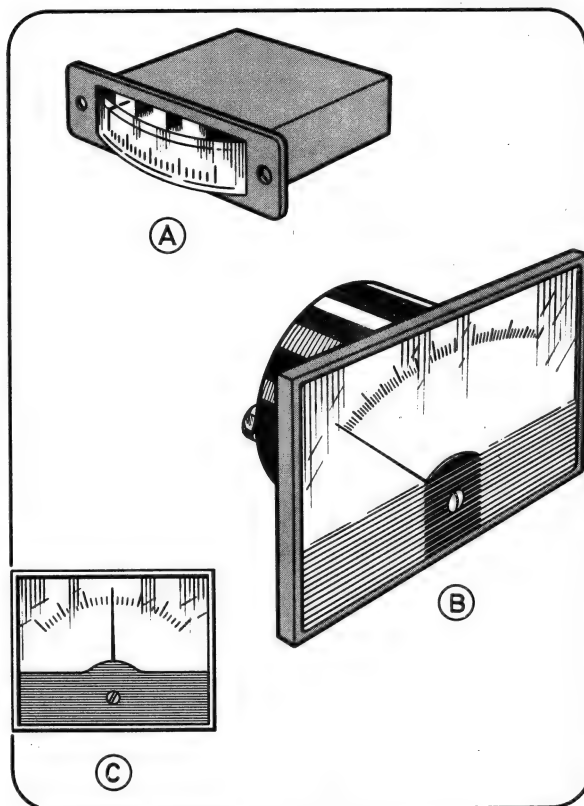
If we had a thick piece of copper wire we would expect more electrons to move past a given point per unit of time than with a thin piece (Fig. 4). Likewise if our battery had a higher voltage it would seem logical that we would get the same sort of effect. This is exactly what does happen. We call the rate of movement (flow) of electrons the **electric current**, the battery voltage is the pressure or motive force driving them, we call this the **electro motive force** (e.m.f. for short) and the copper wire is the conductor which has the ability of allowing large numbers or small numbers of electrons to move depending on its area of cross section; we call this the **resistance** to flow.

WATER ANALOGY

Having defined the basic elements of a real electric current let us now return to our analogy with water. We have already used the terms pressure and flow. We can demonstrate electrical resistance by having a water pipe of small bore connected in series with a pump—similar to a domestic central heating system. The smaller the bore, or the more radiators we have, the higher the pressure we need from our pump to maintain the flow.

It is common practice to measure water pressures relative to a given "head" of water. At the inlet of the pump the pressure is zero because this is our reference point. At the outlet the pressure will be high and positive and in between the various radiators we will still measure positive pressures but they will get less and less as we go round the circuit (Fig. 5).

If we took the junction of radiators B and C as our reference we would measure positive pressures on the "upstream" side of the point and negative pressures on the "downstream" side. What we are in fact measuring is the "pressure difference" between two points. If we have a high resistance to flow between two points we will get a corresponding high pressure difference. This is exactly what happens with an electric current. Let us replace the pump with a battery and the radiators with electronic components called resistors (Fig. 6.)—these are devices which have been specially designed to restrict the flow of current and have values measured in **ohms**. The drawing on the left shows the components as they would appear in real life but now look at the schematic diagram on the right which uses symbols to represent the components. B1 is the battery, R1, R2, R3, and R4 represent resistors. The voltage (or e.m.f.) of the battery is the driving pressure, say 4 volts. If all the resistors have identical value we can say that relative to the negative terminal of the battery the potential at the junctions of R1 and R2 is +3 volts, between R2 and R3 is +2 volts and between R3 and R4 is +1 volt.

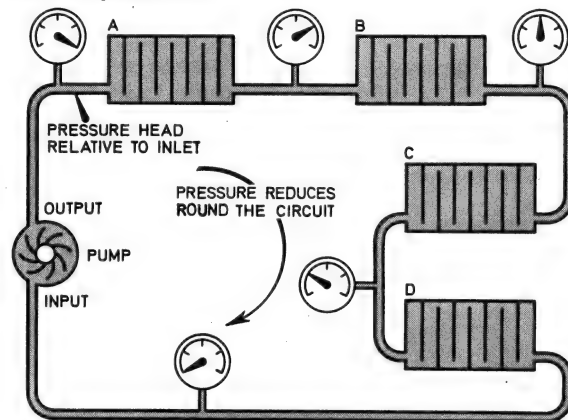


Three types of moving coil meters. A. Edge wise type. B. The "standard" type used in the Demo Deck. C. Centre zero type.

MEASURING CURRENT

It is all very well talking about currents and potential differences but how do we measure them? We have seen that a current flowing through a resistor produces a potential difference. Similarly an e.m.f. across a resistor will produce a current. There is a relationship between these, therefore we should be able to measure potential difference in terms of current. This will be covered in more detail later.

Fig. 5. Water analogy of a circuit showing difference in pressures.



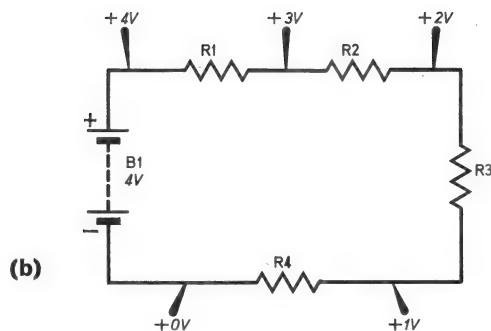
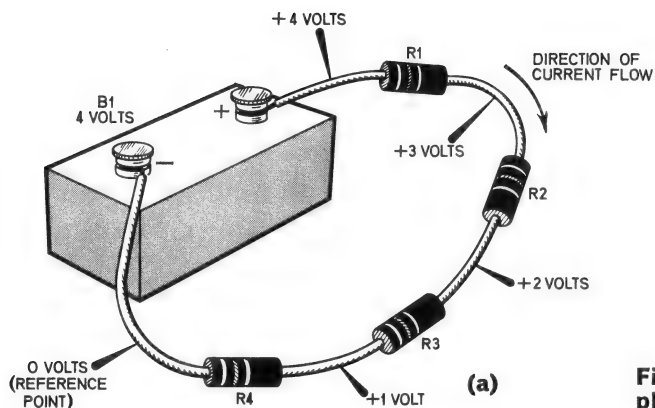
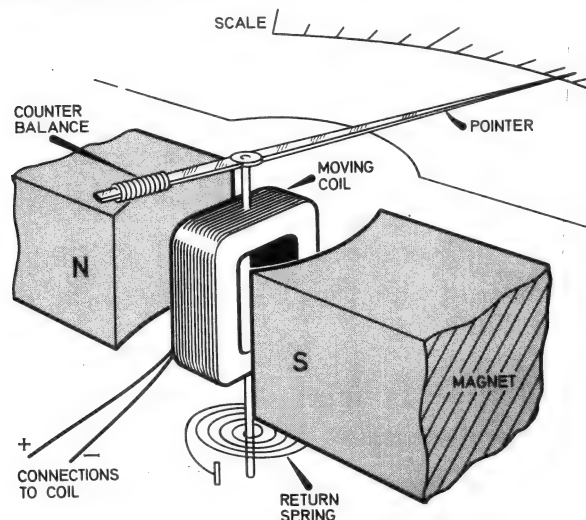


Fig. 6(a). The electronic components that replace Fig. 5. **(b).** The electronic Circuit diagram.

Most instruments in their basic form measure current and are modified to use the relationship mentioned to measure potential difference (voltage). The most common type in use today is the moving coil galvanometer. A small electric current made to pass through a coil of wire pivoted in a strong magnetic field makes the coil move on its pivot against the action of a spring (Fig. 7). A fine pointer attached to the coil moves over a graduated scale calibrated in units of current (amp or fractions of an amp).

Moving coil meters are specified in terms of their sensitivity. For example those used in cars do not have to be very sensitive as the currents measured are very high (10-20 amp) and the coil is usually only a turn or two of very heavy wire. In electronics we are usually concerned with minute electric currents in the order of thousandths or even millionths of an amp and it is quite common to have a meter having a full scale deflection of 100 millionths of an amp (100 microamp). The wire used for the coil in this case is extremely fine and there are many turns. The price of meters is directly proportional to

Fig. 7. Basis of the movement of a moving coil galvanometer.



their size and sensitivity; obviously it is not sensible to buy something that is too good for an application but when obtaining a meter it is always better to err on the side of higher sensitivity—it can always be reduced.

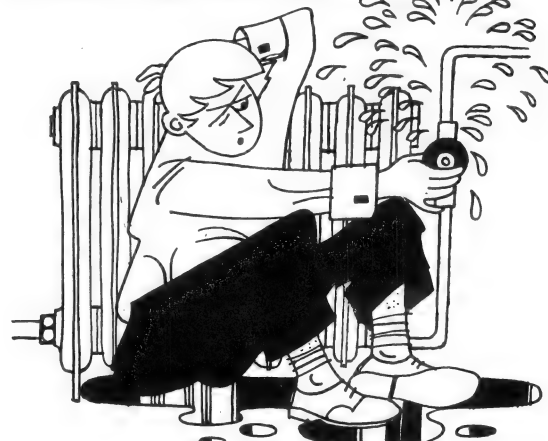
Next month we shall go into more detail about the relationship between current, potential difference and resistance and will carry out some simple experiments. In preparation for this it is suggested that this month you make the *Demo Deck*. This "table top laboratory" will be used frequently during the series and for those with a limited amount of working space it should permit work on the dining room table without too many severe repercussions!

You might be tempted to start experimenting with the *Demo Deck* at this stage; if you are, be extremely careful that you do not pass excessive current through the meter. If you do not understand what this means it is safer to leave things as they are until next month when we shall be putting the deck through its paces, using a few extra components.

The electronic components required are:

2 1,000ohm $\pm 10\%$ $\frac{1}{4}$ watt resistors, 2 10,000 ohm $\pm 10\%$ $\frac{1}{4}$ watt resistors and 2 22,000ohm $\pm 10\%$ $\frac{1}{4}$ watt resistors

Next month: Ohm's law explained and used to make a volt meter on the Demo Deck



Exclusive money-saving offer to our readers



BEGINNER'S TOOL KIT

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£1-97



- **BIB WIRE STRIPPERS & CUTTERS**
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This valuable set of tools contains the items we described in "Teach-In" for beginners last month as being essential to anyone setting out to enjoy the hobby of electronics. Having the right tools makes the job that much easier to do.

Take advantage of this great offer, exclusive to readers of "Everyday Electronics". Send for your Beginner's Tool Kit today.

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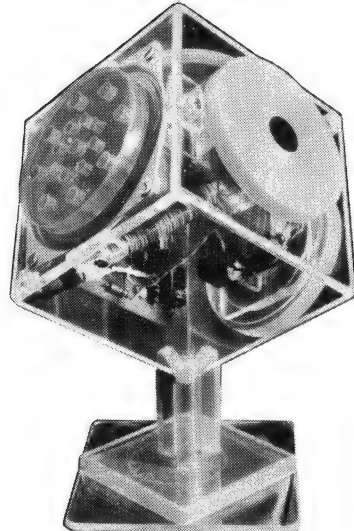
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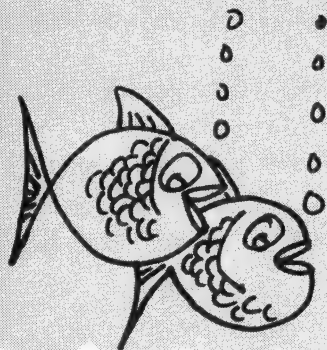
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CLEARLY

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Astron M.W. RECEIVER

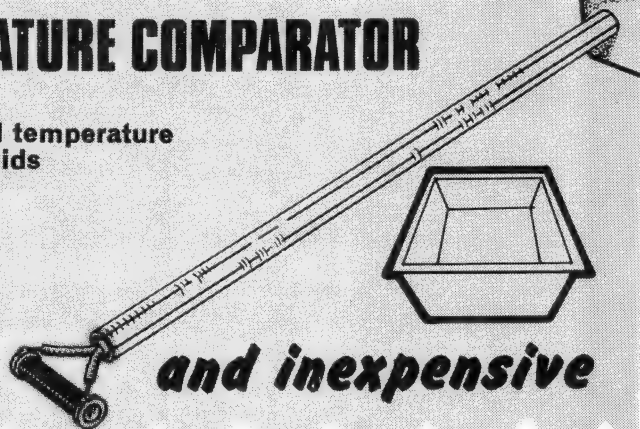


..AND THE REMOTE TEMPERATURE COMPARATOR



Measures small temperature
changes in liquids

...simple



and inexpensive

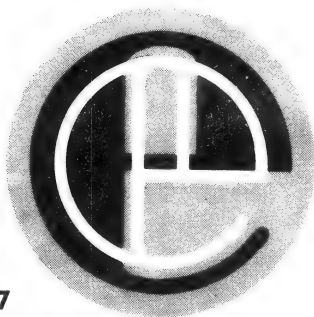
ELECTRONICS AND THE MUSIC SCENE

Describes the way in which electronics has changed the "musical sound" in recent years and the devices that produce the "special effects" now in common use

*Some of the fascinating
features to be found
in the
JAN '72
issue of*

ON SALE

FRIDAY, DECEMBER 17



TEACH-IN PART 3

Explains fully the resistor colour code. Various experiments are carried out using the Demo Deck in which Ohm's law is verified

DEMO DECK

By Mike Hughes M.A.

Demo Deck for everyone who wants to experiment with electronic circuits and in particular for those following Teach-In.

THE Demo Deck has been designed for the constructor who wishes to carry out simple experimental work with the minimum amount of space utilisation, and who desires also the possibility of re-using components several times over. Most particularly it is used as the work horse of the *Teach-In* series and those readers who are following this in a practical sense are strongly advised to make a Demo Deck so that they can perform the exercises and experiments exactly as described.

THE DECK

The deck itself has no circuit diagram but is a flat bed on which is mounted a range of components, together with a sturdy re-usable soldering board. An important feature of the deck for those with limited space is the special cabinet.

The deck is mounted on a specially designed cabinet, this provides accommodation for tools and components and also housing for the loud-speaker and batteries. Thus at the end of experimental work everything can be tidied away neatly and the unit itself—if built well—is quite attractive in appearance.

No doubt it will be repeated in *Teach-In*, but

it is important in any hobby that care is taken—you are your own master but you should set yourself high standards for workmanship and never settle for something that you think you could possibly do better. This is an attitude that should always be taken in electronics because most problems ultimately boil down to untidy or slipshod workmanship. Make as good a job of this table top laboratory as possible; remember you will be using it as a tool for the rest of this series and probably much longer.

There is no need to follow the details exactly, but those following *Teach-In* are advised not to deviate too far from the published design. Some more advanced constructors may like to use the basic design suitably modified to their own purposes. For the benefit of beginners we shall

Approximate cost of components



5.50 plus cabinet

Potentiometers

- VR1 100 ohm wirewound
- VR2 5,000 ohm (5 kilohm) carbon
- VR3 25,000 ohm (25 kilohm) carbon
- VR4 500,000 ohm (500 kilohm) carbon

Lamps

- LP1 6 volt 0.06 amp MES bulb and holder
- LP2 6 volt 0.06 amp MES bulb and holder

Loudspeaker

- LS1 35 ohm $3\frac{3}{8}$ inch diameter (R.S. Components)

Meter

- ME1 1 milliamp full scale deflection moving coil meter with $1\frac{1}{2}$ inch square face (S.E.W. type MR38P)

Battery

- B1 $4\frac{1}{2}$ volt screw terminal bell battery (2 off)

Miscellaneous

- 1 small perforated board (R.S. Components)
- 1 gross box small turret tags (R.S. Components)
- 2 ten way 2 amp terminal blocks (R.S. Components Barrier Strip 2A)
- 6 Slim screw terminals, different colours (R.S. Components)
- Banana plugs to fit screw terminals (optional accessory)—if alternative terminals are used these may not have facility for plugs
- Small or medium crocodile clips (optional accessory)
- 2 yards (approx.) single strand insulated connecting wire
- 2 yards (approx.) light duty twin flex (for leads to B1 and LS1)
- 2 yards (approx.) seven strand insulated connecting wire (for connecting leads)
- Aluminium or other material for chassis (see text)
- Wood for housing (see Fig. 5). Lettering sheet. Varnish etc.

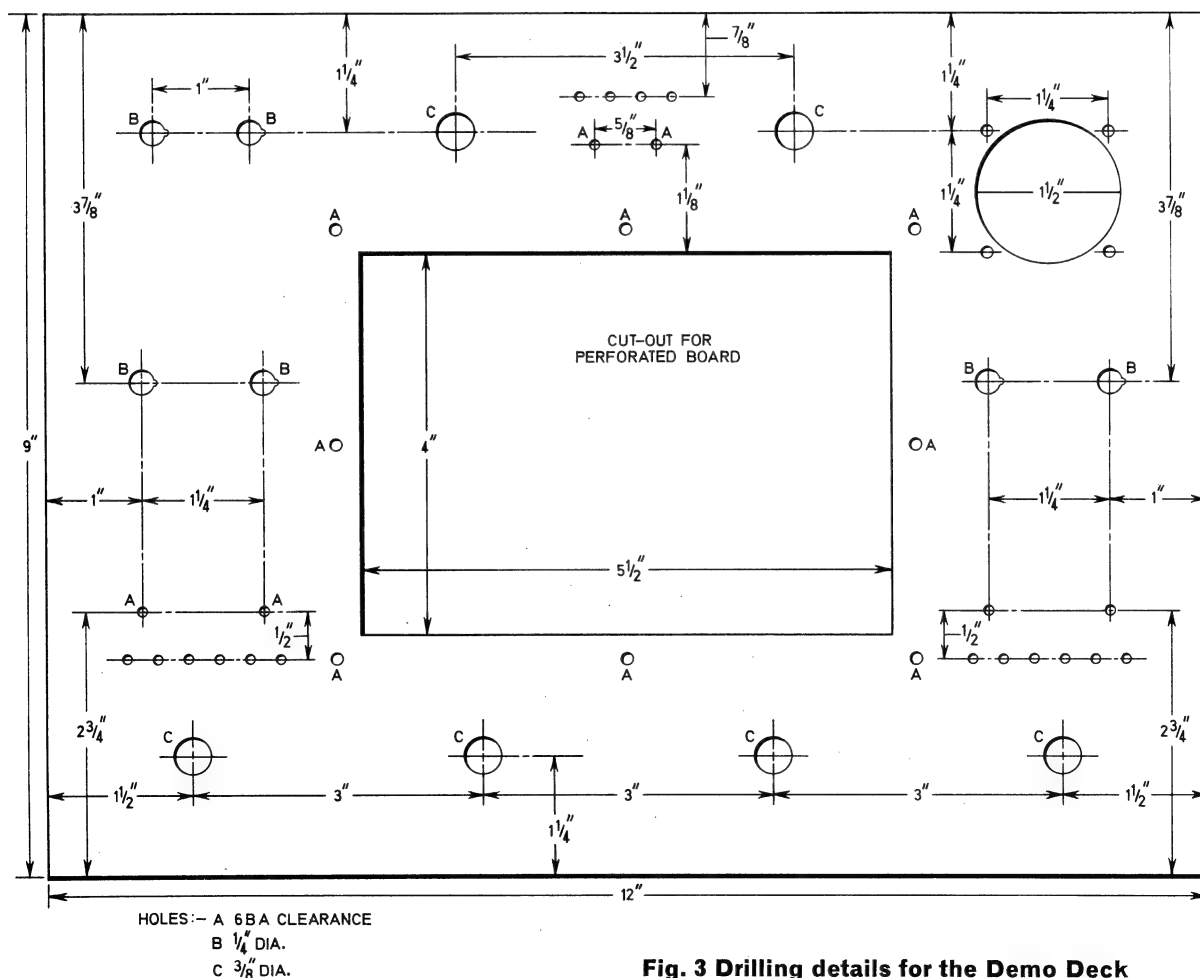


Fig. 3 Drilling details for the Demo Deck

the layout drawing (Fig. 3). It is as well to check the diameter of fixing holes because some components of different manufacture can vary in physical dimensions.

Check that the potentiometers, lamp holders, terminals and meter will fix correctly and then finish off the surface of the Demo Deck. If aluminium is used, make a satin finish by scrubbing the surface in a horizontal direction with fine grade wire wool; lightly dust off the metallic powder produced without getting finger marks on the surface and immediately apply a coat of polyurethane varnish. When dry apply lettering either with transfers or Letraset and then give a final protection coat of varnish. If you have used a wooden surface apply one or two coats of a hard gloss paint and when dry carry out the lettering as above. Finish off with a coat of clear varnish. Each tag should be identified by a number/letter code and this can be applied to the chassis around the edge of the board. The designations are applied as shown in Fig. 1.

WIRING

Now is the time to mount permanently all the components. Take care when handling the 1 milliamp meter and make sure that you have the potentiometers mounted in the right places. If necessary cut the shafts of the potentiometers, to take the knobs, before mounting on the deck. The values of resistance are printed on the side of the potentiometer cans. The underside wiring is only to route the terminals of the components to the Demo Deck terminals

and Fig. 4 shows the details. Take note that there is a cross-over in the wiring sense of the potentiometer terminals and ensure that the polarity of the meter is correct. All meters should have the positive terminal marked + or with a red spot of paint. Leave the flying leads from the battery and loudspeaker terminals about 18 inches long: these will be connected to the components mounted in the wooden cabinet.

Set the deck aside and make a suitable support. It is recommended that a cabinet similar to that described in Fig. 5 be made. This will hold the batteries and loudspeaker, as well as having a compartment for tools and small extra components. Fig. 5 shows an exploded view of the prototype design. Make sure that you leave sufficient room to gain access to the batteries and that the rear of the loudspeaker is protected.

All that remains to be done is to make up some accessory leads. It is suggested that you keep an assortment of single ended and double ended crocodile clip leads and two or three single ended banana plug leads. These will be extremely useful for experimentation and can save a lot of frustrating time wasting.

There is only one word which need be said about the use of the deck. While the tag posts can be re-soldered many times it is worthwhile attempting to use the minimum amount of solder otherwise there will be a tendency to build up a large "blob" which can be annoying and ultimately make further soldering difficult. Should the wiring panel reach a condition when it can no longer be used it can be replaced simply by undoing the eight screws and dropping it out. ▣

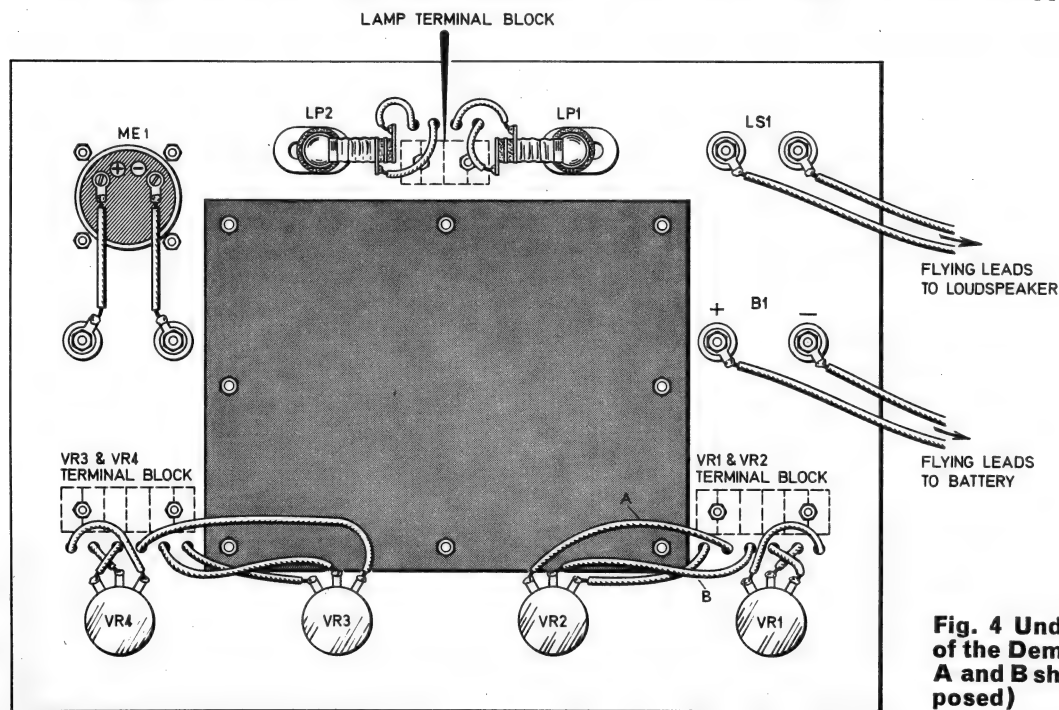


Fig. 4 Underside wiring of the Demo Deck (wires A and B should be transposed)

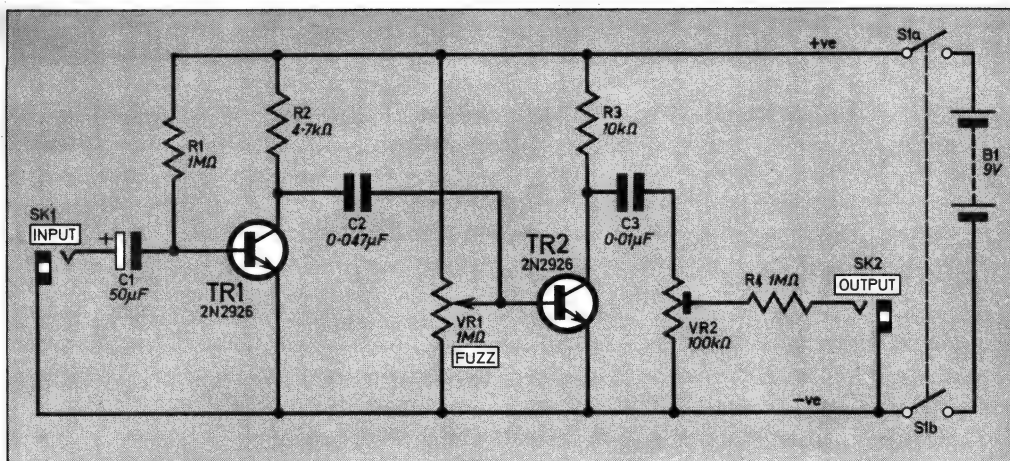


Fig. 1. The circuit diagram of the fuzz box.

flying leads on the board as shown, taking special care when soldering the transistors. It is recommended that a heat shunt be used, such as a pair of pliers gripping the transistor lead being soldered. This conducts away the heat from the soldering iron which would otherwise damage the transistor.

Some form of insulation should be placed between the Veroboard and the lid to ensure there is no "shorting" of the rear of the Veroboard by the metal lid. A piece of insulation tape stuck to the lid, under the Veroboard, is sufficient to prevent this.

CASE CONSTRUCTION

The size, shape and material of the case may be tailor-made to individual requirements, but the one shown in the photograph and described here was, besides having a neat appearance, found to be easy to construct and readily able to house all the components in a neat and tidy fashion.

The prototype case was made from 1/16in. thick aluminium sheet to the dimensions given in Fig. 3.

All holes should be drilled before the metal is bent to shape.

The holes for fixing SK1, SK2, and VR1 will require large drill bits, up to 1/2in. diameter. If these are not available, a smaller hole should be drilled first and then filed with a circular file until the correct size is obtained.

The slot for accommodating the slide on-off switch is easiest made using the "drill and file" method. That is, drill holes at the extremes of the rectangular area to be removed and then straighten up the perimeter with a small file.

The lid, which forms the base, is made from the same material as the body of the case and should have a 1/4in. lip to enable attachment to the body by means of 2 small self-tapping screws.

The case is now ready for assembly.

ASSEMBLY

Fix SK1, SK2, VR1 and S1 firmly in their positions in the case as shown in Fig. 4, and then wire them to the Veroboard. The length of all these wires should be about 5 to 6 inches.

Screened cable must be used for the connections between SK1, SK2 and the Veroboard. This eliminates interference.

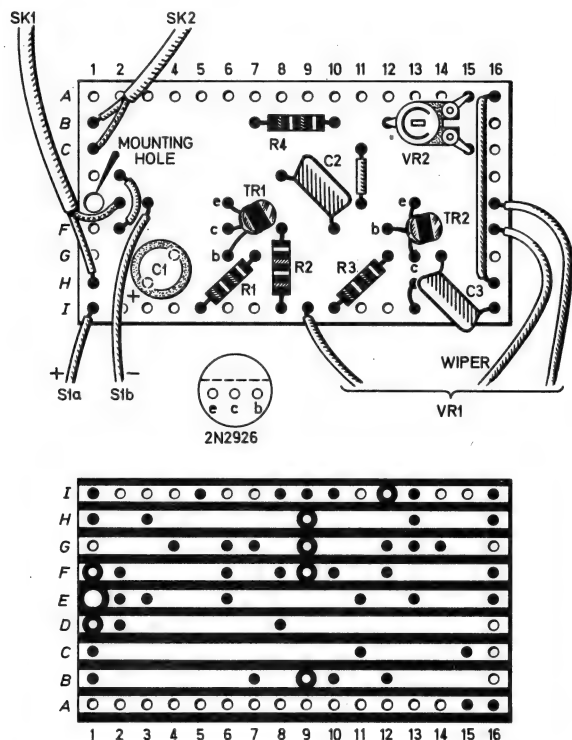


Fig. 2. The layout of the components on the top side and underside of the veroboard. Note that the flying leads to SK1 and SK2 are of screened cable. The transistor base connections as viewed from underneath are shown below. The larger drilled hole at E1 is for mounting purposes.

ANTEX

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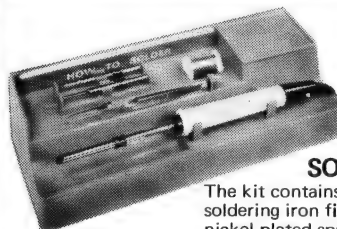
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SK. 1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder." Also available for 220 volts.

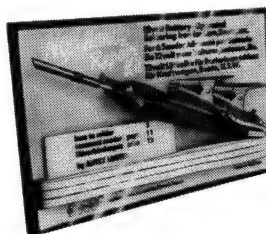
Price £2.75



SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

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MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet.

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Please send the following:

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EE.2

Connect the battery terminal as shown in Fig. 4 making sure that the polarity is correct, otherwise damage to the transistors may result.

All that remains to be done is to fix the Vero-board to the lid by means of a small nut and bolt, clip in the battery and secure the lid. The fuzz box is now complete and ready for use.

If required a foot switch may be included in the fuzz box to switch in and out the fuzz effect. Such a switch must be arranged to connect the input to the output (SK1 to SK2) and screened lead should be used to wire up the switch.

USES

The fuzz box is used extensively and mostly by "groups" for lead guitar where it is placed between the guitar and the main amplifier, but it may be employed for effect with almost any instrument, such as bass guitar, electronic organ, and even microphone. Weird and interesting sounds may be obtained by using the fuzz box

in conjunction with a microphone used to amplify musical instruments such as a trumpet and trombone. This device is a must for the musical sound experimenter. □



Ruminations By Sensor

The I.C. man cometh

The reductions in size and production costs and the improvement in reliability of complex electronic systems, brought about by the use of integrated circuits has lead to their incorporation into all kinds of equipment. Apart from the more obvious applications such as computers and kindred equipment, radar, television and communications systems; integrated circuits can now be found in applications as diverse as washing machines, model aircraft control and in fuel injection and ignition systems for motor cars. With these facts in mind, I began to wonder what the future electronic "foreigner" will be like.

Before writing anything else I must hasten to add that I am not going to discuss genetics; a "foreigner", in industrial terms, is a private job carried out on works premises. The foreigner can take many forms, it may be a small repair job which requires facilities not normally available in the home, such as welding or turning, or it may be a complete piece of equipment, designed and built within the works. Foreigners are

usually relatively small in dimensions, or capable of being broken down into small units, so that they can be hidden from authority and eventually smuggled out of the factory.

One thing common to all foreigners is that they seldom reach completion; in the first flush of enthusiasm there is much frenzied activity which is highly infectious. Colleagues will rush to assist with ideas and materials, other departments will lend expertise and facilities, and if these offers of help are not strongly resisted from the outset, the original creator will find that his precious brainchild has been wrenched from his grasp to be broken down into a number of sub projects spread throughout the works.

Further sub-division may then take place and it can be said that the more sub-divisions there are, the less likelihood there is of the project being completed. Also, the rate of working falls off very rapidly after the initial fervour has evaporated—as there are few things more boring than old foreigners, especially other people's foreigners. These rules can be expressed in simplified form as:

$$t_c = F_r U_s T_{rate} + \Sigma I$$

where t_c = time to completion
 F_r = "foreigner receptiveness" (a constant for the factory)

U_s = the number of unit subdivisions

T_{rate} = the rate of toiling

ΣI = the sum of all the inertia factors of everyone involved (similar rules apply to bona fide jobs but F_r is replaced by a term O representing official support).

But what, you may ask, has all this to do with integrated circuits? Well, integrated circuits are small—one of the essential features of a foreigner; (though I heard that a 60 foot maypole was once built as a foreigner; but that is another story!) they are virtually complete in themselves and often merely require connection to a power supply and some ancillary input or output equipment and they are ready for use. A wide range of timing circuits and audio circuits exists and the versatile operational amplifier lends itself to many projects.

Can we expect to see a flood of baby alarms, exposure timers, model railway controllers and electronic roulette games pouring through the factory gates? I think not, for there is still the problem of the box, case or cabinet. This is where the greatest inertia is traditionally encountered and where $F_r U_s T_{rate}$ approaches infinity. Until we discover how to "grow" boxes around our foreigners, they are doomed to remain what they have always been—memorials to frustrated creativity.

28watts, r.m.s. 40Hz to 40kHz $\pm 3\text{dB}$



Viscount III Audio Suite complete £49

There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

PRICES SYSTEM 1

Viscount III R101 amplifier	£22.00 + 90p p&p
2 x Duo Type II speakers,	£14.00 + £2 p&p
Garrard SP25 Mk. III with MAG.	
cartridge plinth and cover	£23.00 + £1.50
	p&p

Total £59.00

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SYSTEM 2

Viscount R101 amplifier	£22.00 + 90p p&p
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cartridge, plinth and cover	£23.00 + £1.50
	p&p

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SYSTEM 3

Viscount III Amplifier R100	£17.00 + 90p p&p
2 x Duo Type II speakers, pair	£14.00 + £2 p&p
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cartridge, plinth and cover	£21.00 + £1.50
	p&p

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SPEAKERS Duo Type II

Size approx 17" x 10½" x 6½". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet. £14 pair + £2 p&p.

Duo Type III Size approx 23½" x 11½" x 9½". Drive unit 13½" x 8½" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32 pair + £3 p&p.

SPECIFICATION R101

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within $\pm 1\text{dB}$ R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. —58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx 13½" x 9" x 3½".

R+TV

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logues in circulation and consequently we shall be receiving too little money for our goods. When the price jump is big, we finish up selling below cost! We must then, either write to you, the customer, asking for more money (which does not help the customer-dealer relationship), or we must lose money.

Many years ago, we took our prices out of our catalogue and put them in a separate supplement as we argued that although we couldn't reprint the catalogue for every price change, at least we could change a price supplement several times a year. Lately, the rapidity of price changes made even this unworkable and we have now installed an Offset Litho Machine to print our own Price Supplements on the spot. Price changes can be made within minutes and at last we are keeping up with them!



... Price changes can be made within minutes

Packing and Postage

One minor problem which I think we have solved fairly well is making a part charge towards the cost of packing and postage. After much thought, we decided to average out the cost of all postage and charge this as a standard rate. At the moment it is 18p per parcel. Naturally the customer who orders some heavy transformers is happy, but the customer who orders 25p worth of resistors less so.

Occasionally a customer might write and say "You charged me 18p for post and packing and I noticed that my 25p worth of resistors were just put in a padded bag with a 3p stamp on it". It is then necessary to point out that our gross profit on the transaction is probably 8p and apart from the bag costing us 3p and the stamp 3p, the staff handling it are earning about 1p per minute! But I must be fair and say we probably receive less than 12 letters a year in this vein. I think even with "cash with

order", that probably all dealers lose money on orders under £1—but again it is a service to the customer. We stress again and again, try and send one big order instead of several small orders, help yourself to save postage and also help us!

Stock Control

Nothing frustrates you, the customer, more than to be told that an item you require is out of stock. You may put this down to bad management and poor stock control. Well, a few years ago, one of the giants in the electronic components industry decided to go into the retail side, and produced magnificent catalogues, spent thousands in advertising and yet after a year or two, it was obviously not going according to plan.

Knowing that we had achieved a very modest success in the business, two of the firms executives came and took my partner and I to lunch and it was apparent they wanted to find out what made us tick! When they got round to stock control, they said "What do you do?" and we said "What do you do?" "Well," they said, "when an order comes in it is fed into the computer. The computer makes out the invoice, types the label, checks the stock, and when the stock falls below a certain pre-determined level, re-orders! And now, what do you do?"

"Oh!" we replied, "well if we pick up a box and it's empty, we re-order, if the box is battered and worn out (they are cardboard by the way) we obviously should order bigger quantities, if there is more than a certain pre-determined thickness of dust on the box, this item is a slow seller and should be discontinued."

The two executives stared at us in disbelief until we convinced

... more than a certain predetermined thickness of dust



them that we were telling them the truth, and when we pressed them, they admitted they were out of stock of various goods far more often than we were!! We then went on to tell them why—there are too many variables for any computer to cope with, therefore one might just as well do it the simplest way!

Next month I will discuss the influence of magazine constructional articles upon the supply situation.

EVENING ELECTRONICS

Many readers, both newcomers to electronics and experienced hobbyists, may be interested in evening classes or clubs for electronic enthusiasts. There are many evening classes run for both beginners and experienced constructors all over the country and we know that some evening institutes run more than one course. Although these courses will have been going on for more than a month when you read this, most of them will gladly accept newcomers.

If you are interested in joining such a class, we recommend you to get in touch with your local education authority, who can inform you of all the courses in your area. For Londoners the booklet "Floodlight" available from most newsagents gives all the courses being held in the Greater London area.

As well as evening classes there are some electronics clubs operating within the British Isles, the largest of these being the British Amateur Electronics Club. For more information about this club and its activities please write to:

Mr. C. Bogod, The Secretary,
B.A.E.C., 26 Forrest Road,
Penarth, Glamorgan.

EVERYDAY ELECTRONICS may be visiting some evening classes and club activities and reporting on them during the coming months. So if you run or belong to such a group and you feel that you have something interesting to show us or that the arrangement and activities of your group warrant mention, then let us know.

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TYPESW.100
100 x 80 mm.

50μA.....	\$3.80	20V. D.C.....	\$3.10
50-0-50μA.....	\$3.45	50V. D.C.....	\$3.10
100μA.....	\$3.20	300V. D.C.....	\$3.10
100-0-100μA.....	\$3.45	1 amp. D.C.....	\$3.10
500μA.....	\$3.35	5 amp. D.C.....	\$3.10
1mA.....	\$3.10	300V. A.C.....	\$3.10
		VU Meter.....	\$3.75

BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts



50μA.....	\$3.20	5 amp.	\$3.80
50-0-50μA.....	\$3.10	300V. D.C.....	\$3.80
100μA.....	\$2.75	1 amp. D.C.....	\$3.80
100-0-100μA.....	\$3.10	5 amp. D.C.....	\$3.80
500μA.....	\$3.00	300V. A.C.....	\$3.80
1mA.....	\$2.80	VU Meter.....	\$3.37
20V. D.C.....	\$2.60		

"SEW" CLEAR PLASTIC METERS

Type MR.55P. 4 1/2in. x 4 1/2in. fronts.



50μA.....	\$3.60	10V. D.C.....	\$2.80
50-0-50μA.....	\$3.10	20V. D.C.....	\$2.80
100μA.....	\$3.10	50V. D.C.....	\$2.80
100-0-100μA.....	\$3.00	300V. D.C.....	\$2.80
200μA.....	\$3.00	15V. A.C.....	\$2.10
500μA.....	\$2.90	300V. A.C.....	\$2.10
500-0-500μA.....	\$2.80	S Meter 1mA.....	\$2.80
1mA.....	\$2.80	5 amp. A.C.*.....	\$2.80
1-0-1mA.....	\$2.80	10 amp. A.C.*.....	\$2.80
10mA.....	\$2.80	20 amp. A.C.*.....	\$2.80
		30 amp. A.C.*.....	\$2.80

Type MR.52P. 2 1/2in. square fronts.

50μA.....	\$3.10	10V. D.C.....	\$2.00
50-0-50μA.....	\$2.60	20V. D.C.....	\$2.00
100μA.....	\$2.60	50V. D.C.....	\$2.00
100-0-100μA.....	\$2.50	300V. D.C.....	\$2.00
500μA.....	\$2.30	15V. A.C.....	\$2.10
500-0-500μA.....	\$2.20	300V. A.C.....	\$2.10
1mA.....	\$2.20	S Meter 1mA.....	\$2.10
5mA.....	\$2.00	VU Meter.....	\$2.10
10mA.....	\$2.00	1 amp. A.C.*.....	\$2.00
50mA.....	\$2.00	5 amp. A.C.*.....	\$2.00
100mA.....	\$2.00	10 amp. A.C.*.....	\$2.00
500mA.....	\$2.00	20 amp. A.C.*.....	\$2.00
1 amp.....	\$2.00	30 amp. A.C.*.....	\$2.00
5 amp.....	\$2.00		

Type MR.65P. 3 1/2in. x 3 1/2in. fronts.

50μA.....	\$3.37	10V. D.C.....	\$2.20
50-0-50μA.....	\$2.75	20V. D.C.....	\$2.20
100μA.....	\$2.75	50V. D.C.....	\$2.20
100-0-100μA.....	\$2.65	300V. D.C.....	\$2.20
200μA.....	\$2.65	15V. A.C.....	\$2.20
500μA.....	\$2.40	300V. A.C.....	\$2.20
500-0-500μA.....	\$2.40	S Meter 1mA.....	\$2.37
1mA.....	\$2.20	VU Meter.....	\$2.37
5mA.....	\$2.20	50mA A.C.*.....	\$2.20
10mA.....	\$2.20	100mA A.C.*.....	\$2.20
50mA.....	\$2.20	200mA A.C.*.....	\$2.20
100mA.....	\$2.20	500mA A.C.*.....	\$2.20
500mA.....	\$2.20	1 amp. A.C.*.....	\$2.20
1 amp.....	\$2.20	5 amp. A.C.*.....	\$2.20
5 amp.....	\$2.20	10 amp. A.C.*.....	\$2.20
		20 amp. A.C.*.....	\$2.20
		30 amp. A.C.*.....	\$2.20
		5V. D.C.....	\$2.20

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SEW EDUCATIONAL METERS



Type ED.107. Size overall 100mm x 90mm x 108mm.

A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The

meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA.....	\$5.00	20V. d.c.....	\$4.40
100μA.....	\$4.50	50V. d.c.....	\$4.40
1mA.....	\$4.40	300V. d.c.....	\$4.40
50-0-50μA.....	\$4.45		
1-0-1mA.....	\$4.40	Dual range	
1A d.c.....	\$4.40	200mA/5A d.c.....	\$4.45
5A d.c.....	\$4.40	5V/50V d.c.....	\$4.45
10V d.c.....	\$4.40		

"SEW" BAKELITE PANEL METERS

Type MR.65. 3 1/2in. square fronts.



25μA.....	\$3.50	500mA.....	\$2.90
50μA.....	\$2.75	1 amp.....	\$2.90
50-0-50μA.....	\$2.35	5 amp.....	\$2.90
100μA.....	\$2.35	30 amp.....	\$2.90
100-0-100μA.....	\$2.25	50 amp.....	\$2.90
500μA.....	\$2.20	5V. D.C.....	\$2.90
1mA.....	\$2.90	10V. D.C.....	\$2.90
1-0-1mA.....	\$2.90	20V. D.C.....	\$2.90
10mA.....	\$2.90	50V. D.C.....	\$2.90
50mA.....	\$2.90	150V. D.C.....	\$2.90
100mA.....	\$2.90	300V. D.C.....	\$2.90
		30V. A.C.*.....	\$2.95
		50V. A.C.*.....	\$2.95
		150V. A.C.*.....	\$2.95
		300V. A.C.*.....	\$2.95
		500mA A.C.*.....	\$2.95
		1 amp. A.C.*.....	\$2.95
		5 amp. A.C.*.....	\$2.95
		10 amp. A.C.*.....	\$2.95
		20 amp. A.C.*.....	\$2.95
		30 amp. A.C.*.....	\$2.95
		50 amp. A.C.*.....	\$2.95
		VU Meter.....	\$3.10



EDGWISE METERS

Type PE.70. 3 1/2in. x 1 1/2in. x 2 1/2in. deep.

50μA.....	\$3.10	500μA.....	\$2.75
50-0-50μA.....	\$3.00	1mA.....	\$2.45
100μA.....	\$3.00	300V. A.C.....	\$2.45
100-0-100μA.....	\$2.90	VU Meter.....	\$3.40
200μA.....	\$2.90		

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MULTIMETERS for EVERY purpose!

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O.P.V. Mirror scale, overload protection 0/6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/300A/60A/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm. —20 to +63 db. \$5.97. P. & P. 15p.



MODEL PL436

20kΩ/Volt D.C. 8kΩ/Volt A.C. Mirror scale. —6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600A/60/600 mA. 10/100K/1 Meg/10 MegΩ. —20 to +46db. \$6.97. P. & P. 12p.



MODEL 5025 57 Ranges,

Giant 5 1/2in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: —125, —25, —1.25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1.5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50A, 2.5, 5, 25, 50, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: —20 to +85 db. \$12.50. P. & P. 17p.

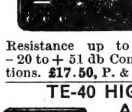
TMK MODEL TW-20CB FEATURES RE-

SETTABLE OVERLOAD BUT-TON. Sensitivity: 20KΩ/Volt D.C. 5KΩ/Volt A.C. D.C. Volts: 0-5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-5, 2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0-5, 50, 500mA, 10 amp. Resistance: 0-5K, 50K, 0-500K. 5 MEG. Decibels: —20 to +52dB. \$11.50. P. & P. 17p.

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TE-40 HIGH SENSITIVITY

A.C. VOLTMETER

10 meg. input 10 ranges: 0/1/003/1/3/1/3/10/30/100/300V. R.M.S. 4cps. —1.5 Mc/s. Decibels —40 to +52dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. \$17.50. Carr. 25p.



TE22 SINE SQUARE WAVE

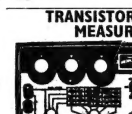
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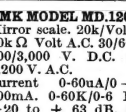
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A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω-11.1 megΩ. 6 Ranges ±1% L. 1μH-111 H. 111H. 6 Ranges ±1% TURNS RATIO 1:1/100A. 1:1/100. 6 Ranges ±1% BRIDGE VOLTAGE at 1,000 cps. Operation from 9 volts. 1000A. Meter indication. Attractive 2 tone metal case. Size 7 1/4 x 5 x 2 1/2in. \$20. P. & P. 25p.



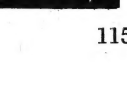
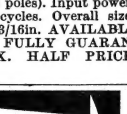
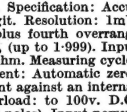
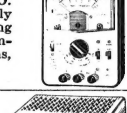
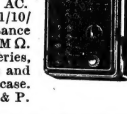
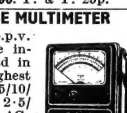
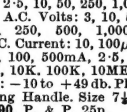
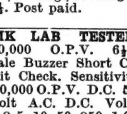
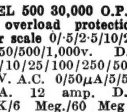
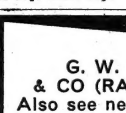
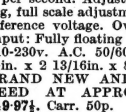
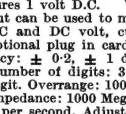
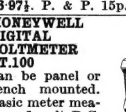
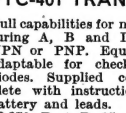
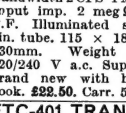
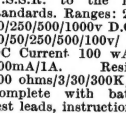
MODEL TE-200 20,000 O.P.V.

Mirror scale, overload protection 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50/100/500/1,000V. A.C. 0/50K/5 megΩ. —20 to +62 db. \$3.75. P. & P. 15p.



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A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2-5/10/50/250/500/1000V. D.C. 2-5/10/50/250/500/1000V. A.C. DC Current 10 mA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3MΩ. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUP PRICE \$5.97 P. & P. 25p.



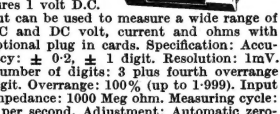
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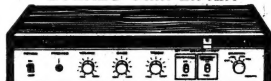
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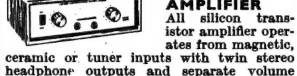
Probably the most popular budget Tuner/Amp. and now offered at a ridiculous low price. 5 watts r.m.s. per channel. Tape/Cer phono inputs. APC/Built-in MPX. List £61. OUR PRICE £28.75. Carr. 50p.
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6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6x4x2 1/2in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 V battery. Coverage 88-108Mc/s. Ready built ready for use. Fantastic value for money. £6.37. P. & P. 12p. Stereo multiplex adaptors £4.97.

HA-10 STEREO HEADPHONE AMPLIFIER



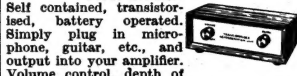
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 60MW. £5.97. P. & P. 15p.

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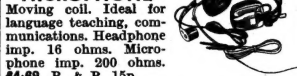
Exceptional budget price amplifier. All silicon transistor. Handsome Walnutcase. Switched input selector. Separate balance, volume, treble, bass controls. Output 2x6W RMS. Inputs Mag. Tape, Xtal, Tuner. Tape Out. £14.75. Carr. 37p.

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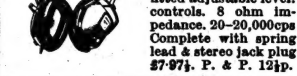
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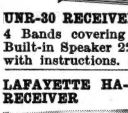
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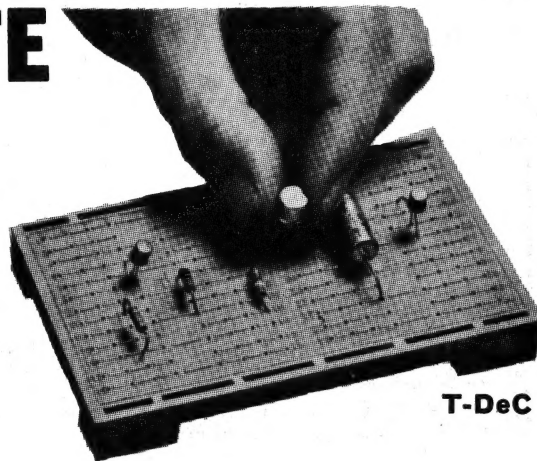
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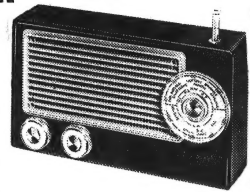
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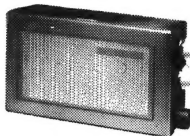
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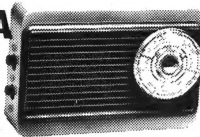
POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ x 1½ x 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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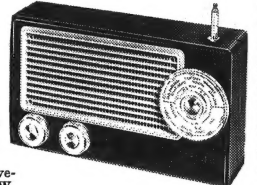


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